SUSQUEHANNA RIVER BASIN

TRIBUTARY OF CHOCONUT CREEK, SUSQUEHANNA COUNTY

PENNSYLVANIA

LAKE TIMBERLINE DAM

NDI No. PA00977

PennDER No. 58-125

Dam Owner: Richard O'Reilly

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

DACW31-81-C-0011

prepared for

DEPARTMENT OF THE ARMY

Baltimore District, Corps of Engineers

Baltimore, Maryland 21203

prepared by

MICHAEL BAKER, JR., INC.

Consulting Engineers

4301 Dutch Ridge Road

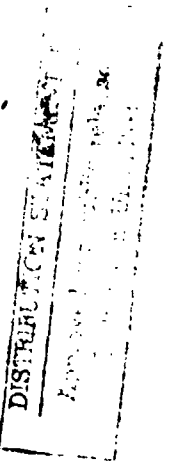
Beaver, Pennsylvania 15009

AUGUST 1981

PREFACE

This report is prepared under guidance contained in the "Recommended Guidelines for Safety Inspection of Dams," for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.



It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I Inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

Lake Timberline Dam, Susquehanna County, Pennsylvania
NDI No. PA 00977, PennDER No. 58-125
Tributary of Choconut Creek
Inspected 30 March 1981

ASSESSMENT OF GENERAL CONDITIONS

Lake Timberline Dam is owned by Richard O'Reilly and is classified as a "Low" hazard - "Small" size dam. The dam was found to be in fair overall condition at the time of inspection.

Hydraulic/hydrologic evaluations, performed in accordance with procedures established by the Baltimore District, Corps of Engineers, for Phase I Inspection Reports, revealed that the spillway capacity is less than the peak inflow to the impoundment during the 100-year flood. A spillway design flood (SDF) in the range of the 50-year flood to the 100-year flood is required for Lake Timberline Dam. The 100-year flood was chosen as the SDF. The spillway is therefore considered "Inadequate." It is recommended that the owner immediately provide adequate spillway capacity.

The inspection revealed certain items of remedial work which should be performed by the owner without delay. These include:

1) Provide adequate spillway capacity.

2) Fill and seed the eroded areas at the downstream ends of the spillway training walls.

3) Place riprap above and below normal pool level on the upstream slope of the embankment.

4) Monitor the seep near the outlet pipe at regular intervals and during periods of high reservoir levels for turbidity and/or increase in flow, which may indicate potential for the piping of embankment material. If turbidity and/or increased flows are noted, a qualified geotechnical engineer should be retained to further evaluate the seepage and to recommend remedial measures.

5) Repair the concrete headwall at the downstream end of the outlet pipe.

(6) Repair or remove the foot bridge across the spillway.

(7) Cut all trees at the toe of the embankment at ground level. All trees with a trunk diameter greater than 3 inches should have their root systems removed. All resultant areas of erosion and cavities should be filled, graded, compacted and seeded.

In addition, the following operational measures are recommended to be undertaken by the owner:

1) Develop a detailed emergency operation and warning system.

2) During periods of unusually heavy rainfall, provide around-the-clock surveillance of the dam.

3) When warning of a storm of major proportions is given by the National Weather Service, activate the emergency operation and warning system.

It is further recommended that formal inspection, maintenance, and operational procedures and records be developed and implemented. These should be included in a formal maintenance and operations manual for the dam.

Submitted by:

MICHAEL BAKER, JR., INC.

John A. Dziubek, P.E.
Engineering Manager-Geotechnical

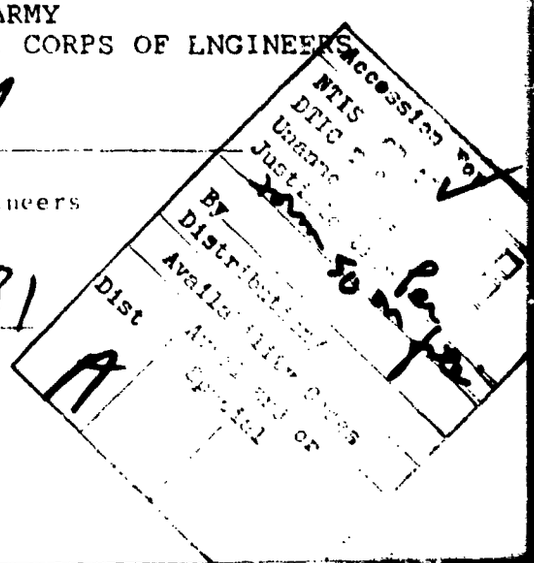
Date: 20 August 1981

Approved by:

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS

JAMES W. Peck
Colonel, Corps of Engineers
District Engineer

Date: 31 Aug 81



LAKE TIMBERLINE DAM

Overall View of Upstream Face of Dam From Right Abutment

Overall View of Downstream Face of Dam From Left Abutment

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
LAKE TIMBERLINE DAM
NDI No. PA 00977, PennDER No. 58-125

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority - The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose of Inspection - The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances - Lake Timberline Dam is an earthfill embankment 201 feet long and 12.6 feet high. The embankment has a crest width of 15 feet and side slopes of 0.6H:1V (Horizontal to Vertical) upstream (above normal pool level) and 1H:1V downstream (located near the outlet pipe), and the remaining areas of the downstream slope are approximately 2H:1V. The upstream face of the embankment is protected with riprap. Plans available for the dam show that a cut-off trench extends the entire length of the embankment. It has a bottom width of 8 feet, a top width of 10 feet and a depth of 5 feet below the upstream toe of the embankment.

The spillway, located near the center of the embankment, consists of a concrete broad-crested weir 30.7 feet long (perpendicular to the direction of flow). Concrete spillway training walls extend 1.6 feet above the crest of the weir.

The outlet works consist of an 18-inch diameter corrugated metal pipe encased in 6 inches of concrete with two 5 foot square - 8 inch wide anti-seep collars. A metal sliding gate valve on the upstream slope controls the submerged intake of the outlet works.

b. Location - Lake Timberline Dam is located on an unnamed tributary to Choconut Creek in Silver Lake Township, Susquehanna County, Pennsylvania. The dam is approximately 2 miles north of Forest Lake.

The coordinates of the dam are N 41° 55.0' and W 75° 58.6'.
The dam can be found on the USGS 7.5 minute topographic quadrangle, Laurel Lake, Pennsylvania.

c. Size Classification - The height of the dam is 12.6 feet. Storage at the top of the dam [Elevation 1418.6 feet Mean Sea Level (ft. M.S.L.)] is 182 acre-feet. Therefore, the dam is in the "Small" size category.

d. Hazard Classification - If the dam should fail, economic damage is likely to result to one home and 3 unoccupied buildings 5600 feet downstream from the dam and 4 to 8 feet above the streambed. Damage to the Township Road 3150 feet downstream from the dam is also likely. Loss of life is considered unlikely; therefore, the dam is considered to be in the "Low" hazard category.

e. Ownership - The dam is owned by Richard O'Reilly, RD #1, Friendsville, Pennsylvania 18818.

f. Purpose of Dam - The impoundment created by the dam is used for recreation and fishing.

g. Design and Construction History - Lake Timberline was designed by L. F. Burlein, P.E., of Honesdale, Pennsylvania, in 1957. The dam was constructed in 1958 and the contractor was H. D. Griffiths of Montrose, PA.

h. Normal Operational Procedures - The reservoir is typically maintained at the spillway crest, Elevation 1417.0 ft. M.S.L.

1.3 PERTINENT DATA

a. Drainage Area (square miles) -	1.28*
b. Discharge at Dam Site (c.f.s.) -	
Maximum Flood -	Unknown
Spillway Capacity at Maximum Pool (El. 1418.6 ft. M.S.L.) -	190.0

*Planimetered from the Laurel Lake, Pennsylvania, USGS 7.5 minute topographic quadrangle.

c. Elevation* (feet above Mean Sea Level [ft. M.S.L.]) -

Design Top of Dam -	1416.0
Minimum Top of Dam -	1418.6
Maximum Design Pool -	Unknown
Spillway Crest -	1417.0
Toe of Dam -	1406.0
Maximum Tailwater of Record -	Unknown

d. Reservoir (feet) -

Length of Maximum Pool (El. 1418.6 ft. M.S.L.) -	1800.0
Length of Normal Pool (El. 1417.0 ft. M.S.L.) -	1700.0

e. Storage (acre-feet) -

Top of Dam (El. 1418.6 ft. M.S.L.) -	182.0
Normal Pool (El. 1417.0 ft. M.S.L.) -	142.0

f. Reservoir Surface (acres) -

Top of Dam (El. 1418.6 ft. M.S.L.) -	22.70
Normal Pool (El. 1417.0 ft. M.S.L.) -	21.12

g. Dam -

Type -	Earthfill
Total Length (feet) -	201.0
Height (feet) - Design -	10.0
Field -	12.6
Top Width (feet) -	15.0
Side Slopes - Upstream - Design -	2H:1V
Field - Varies from to 2H:1V	0.6H:1V
Downstream - Design -	2H:1V
Field - Varies from to 2H:1V	1H:1V
Zoning -	None
Impervious Core -	None
Cut-off - A cut-off trench was designed for installation along the upstream toe of the embankment. The trench was designed 5 feet deep with a bottom width of 8 feet.	
Drains -	None

*All elevations are referenced to the spillway crest, El. 1417.0 ft. M.S.L., as estimated from the USGS 7.5 minute topographic quadrangle, Laurel Lake, Pennsylvania.

h. Diversion and Regulating Tunnels - None

i. Spillway -

Type - Concrete broad-crested weir	
Location - Center of embankment	
Length of Crest Perpendicular to Flow (feet) -	30.7
Crest Elevation (ft. M.S.L.) -	1417.0
Gates -	None
Downstream Channel - Rock lined with a 6-foot diameter culvert 75 feet downstream.	

j. Outlet Works - The outlet works consist of an 18-inch corrugated metal pipe with two 5 ft. by 5 ft. anti-seep collars. A sliding gate valve, located on the upstream side of the crest, controls the submerged intake of the outlet works.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

Information reviewed for preparation of this report consisted of the Pennsylvania Department of Environmental Resources' (PennDER) File No. 58-125. This included:

1) The permit application to the Commonwealth of Pennsylvania Water and Power Resources Board from Richard O'Reilly, owner of the dam (dated 5 August 1957).

2) Cross sections of the reservoir and the earth embankment as proposed by Mr. L. F. Burlein, Registered Engineer. The reference datum for these drawings is unknown.

3) The permit issued by the Water and Power Resources Board allowing construction of the dam (dated 12 August 1957).

4) The final construction inspection report prepared by a representative of PennDER stating that the work appeared satisfactory but that the wasteway channel had not been paved with riprap. (Dated 20 November 1961.)

5) The latest inspection report, dated 17 August 1965, which was filed by PennDER, Division of Dams and Encroachments, stating that the general appearance of the dam was very good.

2.2 CONSTRUCTION

The dam was constructed in 1958. The contractor was H. D. Griffiths of Montrose, PA.

2.3 OPERATION

No formal procedures are followed for operating the dam and reservoir. The spillway is uncontrolled and the reservoir is typically at the spillway crest level.

2.4 EVALUATION

a. Availability - The information reviewed is readily available from PennDER File No. 58-125.

b. Adequacy - The information available, combined with the visual inspection measurements and observations, is considered adequate for a Phase I Inspection of this dam.

c. Validity - There is no reason at the present time to doubt the validity of the available engineering data. However, observations and measurements performed during the visual inspection indicated a few deviations from the design drawings. These are:

1) The spillway crest has been raised and made a broad-crested weir.

2) There is no wheel on the crest of the dam with which to control the gate for the outlet pipe.

3) A foot bridge has been installed across the spillway.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General - The dam was found to be in fair overall condition at the time of inspection on 30 March 1981. No unusual weather conditions were experienced during the inspection. Noteworthy deficiencies observed during the visual inspection are described briefly in the following paragraphs. The complete visual inspection checklist, field sketch, top of dam profile, and typical cross-section are presented in Appendix A.

b. Embankment - Erosion was observed around both downstream ends of the spillway training walls. Minor erosion was also noted along the upstream face of the embankment at normal pool level. Brush and some small trees are growing on the downstream face of the embankment. Clear seepage (approximately 1 g.p.m.) was flowing from the toe of the embankment near the outlet pipe. The embankment slopes appeared to be approximately 2H:1V with the slopes near the outlet pipe appearing to be 1H:1V.

c. Appurtenant Structures - The concrete headwall at the downstream end of the outlet pipe is deteriorated. The outlet end of the outlet pipe appears to be at a higher elevation than the entrance to the pipe. The foot bridge across the spillway is in poor condition.

d. Reservoir Area - The reservoir slopes are moderate and no signs of instability were observed. Sedimentation did not appear to be a problem.

e. Downstream Channel - The downstream channel has mild slopes. The channel passes through a 6-foot culvert under a private road 75 feet downstream from the dam. Located 3150 feet downstream from the dam is a township road. One house and three unoccupied buildings are located 5600 feet downstream of the dam.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

There are no formal procedures for operating the reservoir or evacuating the downstream area in case of an emergency. It is recommended that formal emergency procedures be adopted, prominently displayed and furnished to all operating personnel.

4.2 MAINTENANCE OF DAM

There are no formal records of maintenance or formal procedures for evaluating the necessity of maintenance for the structure. It is recommended that formal inspection procedures be developed.

4.3 MAINTENANCE OF OPERATING FACILITIES

Maintenance is unscheduled. It is recommended that a formal operation and a preventive maintenance schedule be developed and implemented.

4.4 DESCRIPTION OF ANY WARNING SYSTEM

There is no warning system in the event of dam failure. It is recommended that an emergency warning system be developed.

4.5 EVALUATION OF OPERATIONAL ADEQUACY

The current operational features are adequate for the purpose they serve. However, it is recommended that a formal maintenance and operations manual be prepared for the dam.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data - No hydrologic or hydraulic design calculations are available for Lake Timberline Dam.

b. Experience Data - No information concerning the effects of significant floods on the dam is available.

c. Visual Observations - During the visual inspection, no problems were observed which would indicate that the dam and appurtenant facilities could not perform satisfactorily during a flood event.

d. Overtopping Potential - Lake Timberline Dam is a "Small" size - "Low" hazard dam requiring evaluation for a spillway design flood (SDF) in the range of the 50-year flood to the 100-year flood. The 100-year flood was chosen as the SDF.

Using material from "The Hydrologic Study - Tropical Storm Agnes" prepared by the Corps of Engineers New York District, the peak inflow to the impoundment for the 100-year flood was calculated to be 1390 c.f.s. The peak inflow to the impoundment for the 100-year flood was also calculated to be 680 c.f.s., using material from "Water Resources Bulletin, Bulletin No. 13, Floods in Pennsylvania", prepared by the Department of Environmental Resources, Commonwealth of Pennsylvania. Averaging these two methods produced a peak inflow of 1030 c.f.s., which was used in this analysis.

The spillway capacity at the minimum top of dam is 190 c.f.s., which is approximately 19 percent of the peak inflow to the impoundment.

e. Spillway Adequacy - As outlined in the above analysis, the inflow to the impoundment during the 100-year flood is greater than the spillway capacity; therefore, the spillway is considered "Inadequate".

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations - Seepage was observed exiting near the outlet pipe discharge. This area should be monitored in future inspections for an increase in flow and/or turbidity.

b. Design and Construction Data - Calculations of slope and structural stability were not available for review. The dam cross-section indicates a downstream slope of 1H:1V. This slope is present only at the outlet location and the remaining areas of the downstream slope are approximately 2H:1V as designed. The slopes have had a history of satisfactory performance. In view of the modest height of the dam, a history of satisfactory performance of its slopes, and no signs of distress observed during the visual inspection, no further stability analysis is deemed necessary.

c. Operating Records - Nothing in the operational information indicates concern relative to the structural stability of the dam.

d. Post-Construction Changes - No changes adversely affecting the structural stability of the dam have been performed.

e. Seismic Stability - The dam is located in Seismic Zone 1 of the "Seismic Zone Map of the Contiguous United States," Figure 1, page D-30, "Recommended Guidelines for Safety Inspection of Dams." This is a zone of minor seismic activity. Therefore, further consideration of the seismic stability is not warranted since the dam is considered to be structurally stable.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

A. Safety - Lake Timberline Dam was found to be in fair overall condition at the time of inspection. Lake Timberline Dam is a "Low" hazard - "Small" size dam requiring a spillway capacity in the range of the 50-year flood to the 100-year flood. The 100-year flood was chosen as the SDF. As presented in Section 5, the spillway capacity is less than the peak inflow to the impoundment during the 100-year flood. Therefore, the spillway is considered "Inadequate."

b. Adequacy of Information - The information available and the observations and measurements made during the field inspection are considered sufficient for this Phase I Inspection Report.

c. Urgency - The owner should immediately initiate the action discussed in paragraph 7.2.

d. Necessity for Additional Data/Evaluation - The hydraulic/hydrologic analysis performed in connection with this Phase I Inspection Report has indicated the need for additional spillway capacity. It is recommended that the owner provide adequate spillway capacity.

7.2 RECOMMENDATIONS/REMEDIAL MEASURES

The inspection revealed certain items of remedial work which should be performed by the owner without delay. These include:

1) Provide adequate spillway capacity.

2) Fill and seed the eroded areas at the downstream ends of the spillway training walls.

3) Place riprap above and below normal pool level on the upstream slope of the embankment.

4) Monitor the seep near the outlet pipe at regular intervals and during periods of high reservoir levels for turbidity and/or increase in flow, which may indicate potential for the piping of embankment material. If turbidity and/or increased flows are noted, a qualified

geotechnical engineer should be retained to further evaluate the seepage and to recommend remedial measures.

5) Repair the concrete headwall at the downstream end of the outlet pipe.

6) Repair or remove the footbridge across the spillway.

7) Cut all trees at the toe of the embankment at ground level. All trees with a trunk diameter greater than 3 inches should have their root systems removed. All resultant areas of erosion and cavities should be filled, graded, compacted and seeded.

In addition, the following operational measures are recommended to be undertaken by the owner:

1) Develop a detailed emergency operation and warning system.

2) During periods of unusually heavy rainfall, provide around-the-clock surveillance of the dam.

3) When warning of a storm of major proportions is given by the National Weather Service, activate the emergency operation and warning system.

It is further recommended that formal inspection, maintenance, and operational procedures and records be developed and implemented. These should be included in a formal maintenance and operations manual for the dam.

APPENDIX A

VISUAL INSPECTION CHECK LIST, FIELD SKETCH, TOP OF DAM PROFILE, AND TYPICAL CROSS-SECTION

Check List
Visual Inspection
Phase 1

Name of Dam Lake Timberline Dam County Susquehanna State Pennsylvania Coordinates Lat. N 41°55.0'
NDI #PA 00977
PennDER #58-125
Long. W 75°58.6'

Date of Inspection 30 March 1981 Weather Rain Temperature 60° F.

Pool Elevation at Time of Inspection 1417.2 ft.* M.S.L. Tailwater at Time of Inspection 1408.4 ft. M.S.L.

*All elevations are referenced to the spillway crest, El. 1417.0 ft. M.S.L. as estimated from the USGS 7.5 minute topographic quadrangle, Laurel Lake, Pennsylvania.

Inspection Personnel:

Michael Baker, Jr., Inc.:

James G. Ulinski
Jeff L. Sawyer
Gary W. Todd

Owner's Representatives:

James G. Ulinski Recorder

CONCRETE/MASONRY DAMS - Not Applicable

Name of Dam: LAKE TIMBERLINE DAM
NDI #PA 00977

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
LEAKAGE		
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS		
DRAINS		
WATER PASSAGES		
FOUNDATION		

CONCRETE/MASONRY DAMS - Not Applicable

Name of Dam: LAKE TIMBERLINE DAM

NDI #PA 00977

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES		
STRUCTURAL CRACKING		
VERTICAL AND HORIZONTAL ALIGNMENT		
MONOLITH JOINTS		
CONSTRUCTION JOINTS		

EMBANKMENT

Name of Dam LAKE TIMBERLINE DAM
NDI #PA 00977

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Erosion around both downstream ends of the spillway training walls. Minor erosion along the upstream face at normal pool level.	Fill and seed areas of erosion. Place erosion protection on the upstream face of the embankment above and below normal pool level.

EMBANKMENT

Name of Dam LAKE TIMBERLINE DAM

NDI #PA 00977

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	The horizontal and vertical alignment of the crest are good.	
RIPRAP FAILURES	None observed	
VEGETATION	Brush and some small trees are growing on the downstream face of the embankment.	Cut all trees and brush at ground level. All trees with a trunk diameter greater than 3-in. should have their root systems removed. All resultant areas of erosion and cavities should be filled, graded, compacted and seeded.

EMBANKMENT

Name of Dam LAKE TIMBERLINE DAM
NDI #PA 00977

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Good condition.	
ANY NOTICEABLE SEEPAGE	Clear seepage (approximately 1 g.p.m.) 2 ft. upstream from the downstream end of the outlet pipe.	Monitor for turbidity and/or increase in flow.
STAFF GAGE AND RECORDER	None	
DRAINS	None observed	

OUTLET WORKS

Name of Dam: LAKE TIMBERLINE DAM

NDI #PA 00977

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	The outlet pipe isan 18-inch C.M.P. provided with upstream closure. The outlet pipe did not show signs of major deterioration.	
INTAKE STRUCTURE	The intake is submerged. The valve stem is submerged off of the upstream crest of the dam.	
OUTLET STRUCTURE	The outlet pipe is encased in a concrete headwall. A clear seep (est. 1 g.p.m.) was flowing from the toe of the embankment 2 ft. upstream from the end of the pipe. The outlet end of the pipe appears to be at a higher elevation than the entrance to the pipe.	Monitor seep in the future for increase in flow and/or turbidity.
OUTLET CHANNEL	Good condition.	
EMERGENCY GATE		

UNGATED SPILLWAY

Name of Dam: LAKE TIMBERLINE DAM
NDI #PA 00977

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	No problems observed.	
APPROACH CHANNEL	No problems observed.	
DISCHARGE CHANNEL	There is erosion around both sides of downstream end of training walls. The owner reports installing free training material to relieve pressure on the training walls.	
BRIDGE AND PIERS	The footbridge is in poor condition.	Repair or remove footbridge.

GATED SPILLWAY N/A

Name of Dam: LAKE TIMBERLINE DAM
NDI #PA 00977

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL		
APPROACH CHANNEL		
DISCHARGE CHANNEL		
BRIDGE AND PIERS		
GATES AND OPERATION EQUIPMENT		

Name of Dam: LAKE TIMBERLINE DAM
NDI #PA 00977

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None	
OBSERVATION WELLS	None	
WEIRS	None	
PIEZOMETERS	None	
OTHER	None	

RESERVOIR

Name of Dam: LAKE TIMBERLINE DAM

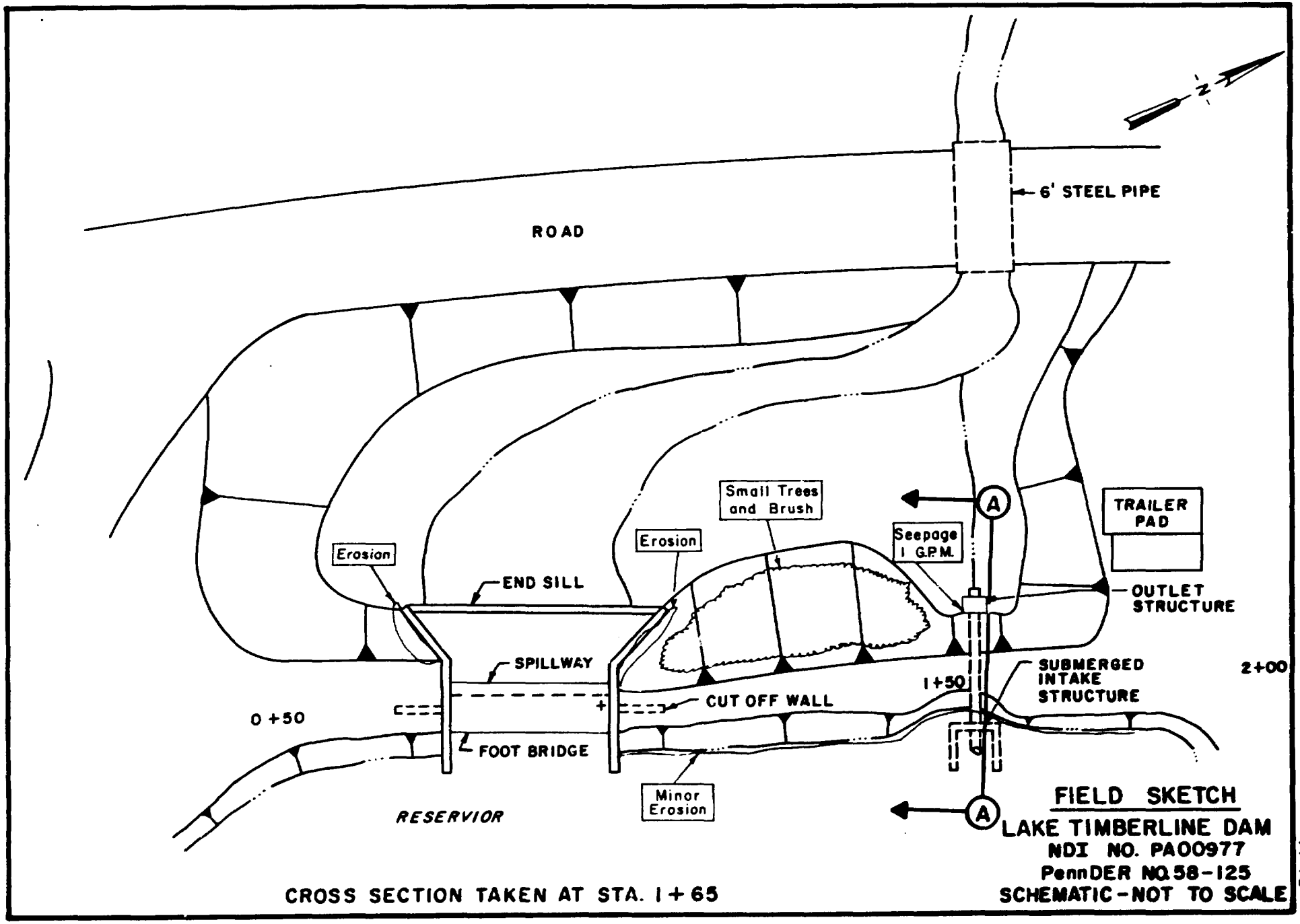
NDI #PA 00977

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	The reservoir slopes are mild and no problems were observed.	
SEDIMENTATION	No problem observed.	

DOWNSTREAM CHANNEL

Name of Dam: LAKE TIMBERLINE DAM
NDI #PA 00977

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	A private road is located immediately downstream with a 6-ft. diameter culvert.	
SLOPES	The downstream channel slopes at approximately 1.5 percent. The side slopes are mild.	
APPROXIMATE NO. OF HOMES AND POPULATION	One home and 3 unoccupied buildings are located 5600 ft. downstream from the dam. These structures are from 4 to 8 ft. above the stream bed.	All of the structures are likely to suffer economic damages were the dam to fail.


N
6' STEEL PIPE
ROAD
Small Trees and Brush
Erosion
Erosion
Seepage 1 G.P.M.
A
TRAILER PAD
END SILL
OUTLET STRUCTURE
SPILLWAY
SUBMERGED INTAKE STRUCTURE
2+00
1+50
CUT OFF WALL
0+50
FOOT BRIDGE
Minor Erosion
RESERVIOR
A
FIELD SKETCH
LAKE TIMBERLINE DAM
NDI NO. PA00977
PennDER NO. 58-125
SCHEMATIC - NOT TO SCALE
CROSS SECTION TAKEN AT STA. 1+65

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

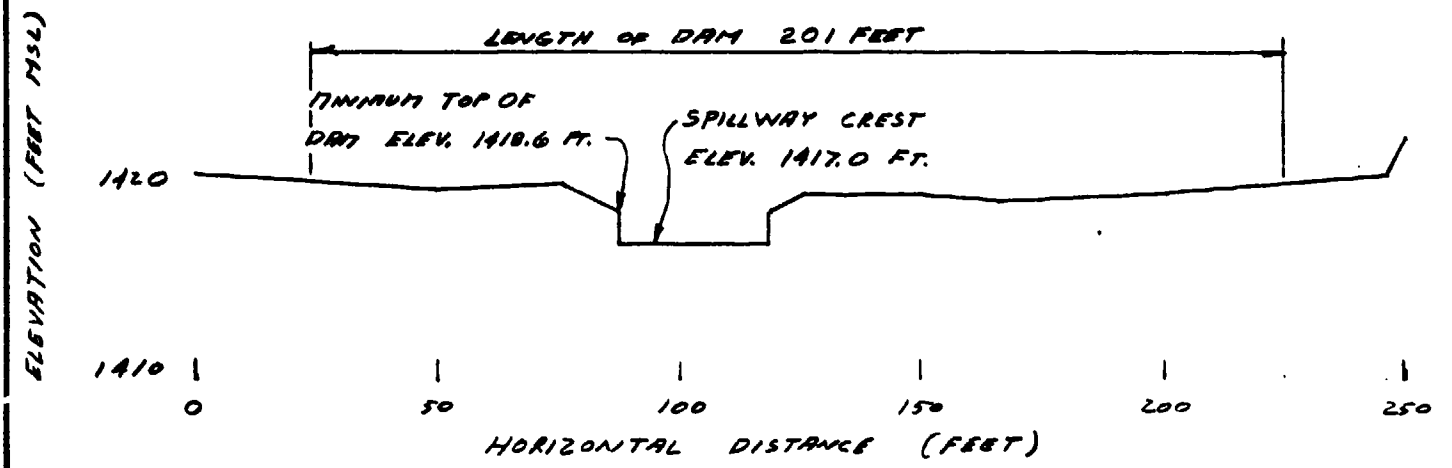
Box 280
Beaver, Pa. 15009

LAKE TIMBERLINE DAM

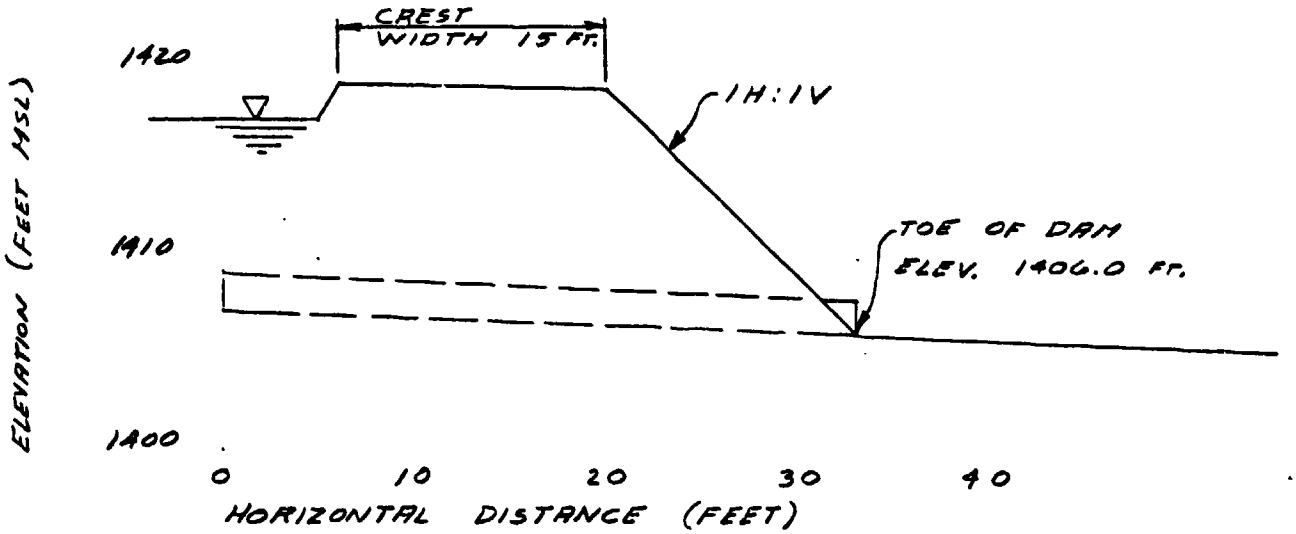
TOP OF DAM PROFILE
TYPICAL CROSS-SECTION

DATE OF INSPECTION: 30 March 1981

TOP OF DAM PROFILE (LOOKING DOWNSTREAM)



TYPICAL CROSS SECTION @ STATION 1+65



APPENDIX B

ENGINEERING DATA CHECK LIST

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

Name of Dam: Lake Timberline Dam
NDI #PA 00977

ITEM	REMARKS
PLAN OF DAM	See Plate 4 of this report.
REGIONAL VICINITY MAP	A USGS 7.5' topographic quadrangle, Laurel Lake, Pennsylvania, was used to prepare the vicinity map which is enclosed in this report as the Location Plan (Plate 1).
CONSTRUCTION HISTORY	The dam was designed by L. F. Burlein, P.E., in 1957. The dam was constructed in 1958. The contractor was H. D. Griffiths of Montrose, PA.
TYPICAL SECTIONS OF DAM	See Plate 5 of this report.
HYDROLOGIC/HYDRAULIC DATA	None available.
OUTLETS - PLAN	See Plate 7 of this report.
- DETAILS	See Plate 7 of this report.
- CONSTRAINTS	None available.
- DISCHARGE RATINGS	None available.
RAINFALL/RESERVOIR RECORDS	None available.

Name of Dam: LAKE TIMBERLINE DAM
NDI #PA 00977

ITEM	REMARKS
DESIGN REPORTS	None available.
GEOLOGY REPORTS	No geology reports are available for the dam. See Appendix F for Regional Geology.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	No design computations are available.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	No information available.
POST-CONSTRUCTION SURVEYS OF DAM	None performed.
BORROW SOURCES	No information available.

Name of Dam: LAKE TIMBERLINE DAM
NDI #PA 00977

ITEM	REMARKS
MONITORING SYSTEMS	None.
MODIFICATIONS	The spillway crest was raised by placing a concrete cap on the existing weir. The left downstream wingwall was replaced in 1978.
HIGH POOL RECORDS	None available.
POST-CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None available.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None.
MAINTENANCE OPERATION RECORDS	None available.

Name of Dam: LAKE TIMBERLINE DAM
NDI #PA 00977

ITEM	REMARKS
SPILLWAY PLAN, SECTIONS, and DETAILS	See Plates 5 and 6 of this report.
OPERATING EQUIPMENT PLANS & DETAILS	None.

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 1.28 sq. mi. (primarily forested)

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 1417.0 ft. M.S.L. (142 acre-feet)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 1418.6 ft. M.S.L. (182 acre-feet)

ELEVATION MAXIMUM DESIGN POOL: Unknown

ELEVATION TOP DAM: 1418.6 ft. M.S.L. (Minimum top of dam)

SPILLWAY:

a. Crest Elevation 1417.0 ft. M.S.L.
b. Type concrete broad-crested weir
c. Width of Crest Parallel to Flow 3.0 ft.
d. Length of Crest Perpendicular to Flow 30.7 ft.
e. Location Spillover center of embankment
f. Number and Type of Gates None

OUTLET WORKS:

a. Type 18-in. corregated metal pipe with a metal slide gate on upstream end
b. Location 50 ft. right of the spillway
c. Entrance Inverts unknown
d. Exit Inverts 1406.0 ft. M.S.L.
e. Emergency Drawdown Facilities The outlet pipe serves as the drawdown facilities

HYDROMETEOROLOGICAL GAGES: None

a. Type
b. Location
c. Records

MAXIMUM NON-DAMAGING DISCHARGE Unknown

APPENDIX C

PHOTOGRAPH LOCATION PLAN AND PHOTOGRAPHS

DETAILED PHOTOGRAPH DESCRIPTIONS

Overall View of Dam

Top Photo (OV-T) - Overall View of Upstream Face of Dam from Right Abutment

Bottom Photo (OV-B) - Overall View of Downstream Face of Dam from Left Abutment

Photograph Location Plan

Photo 1 - View of Entrance to Spillway

Photo 2 - View Across Spillway

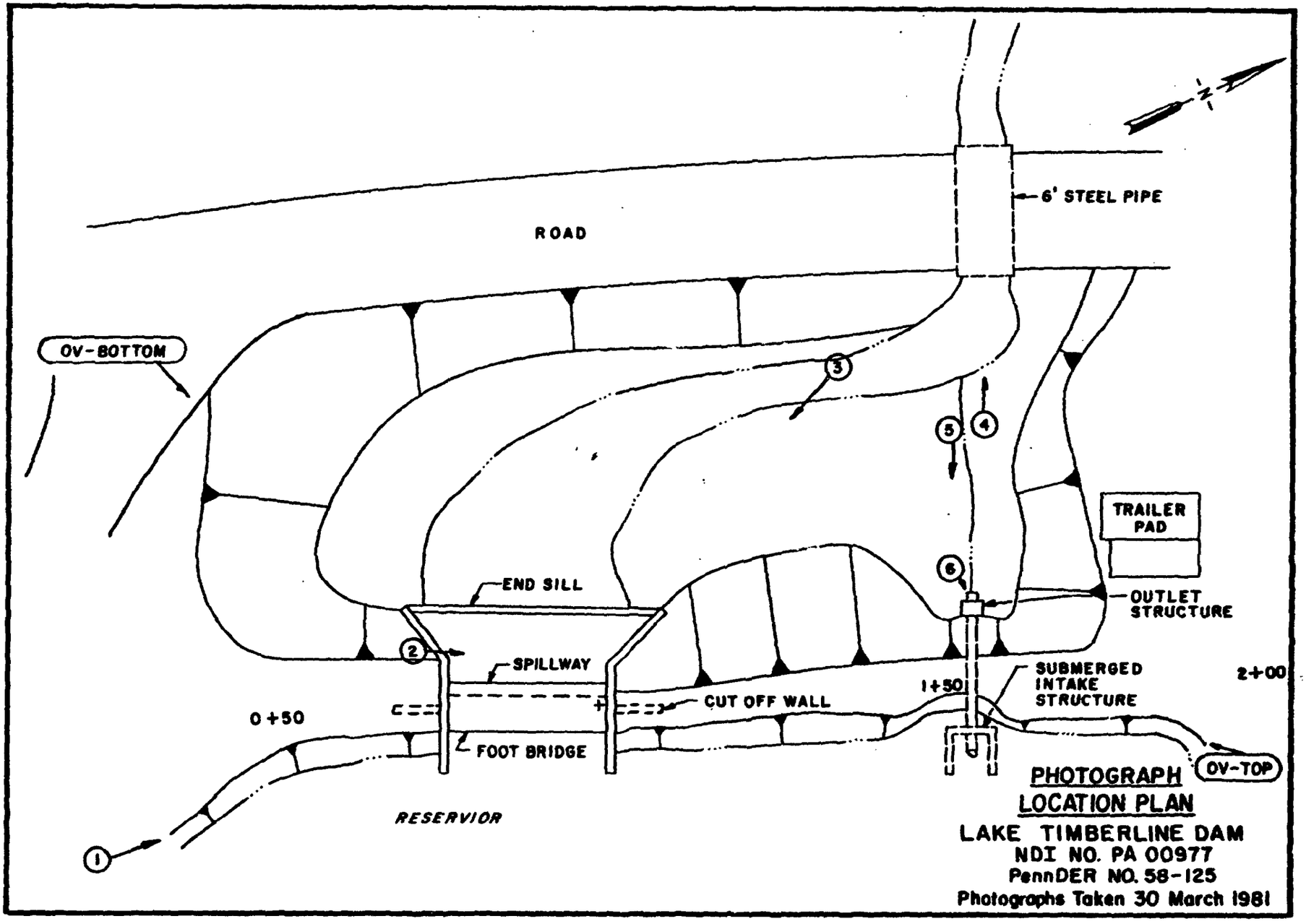
Photo 3 - View of Downstream Side of Spillway

Photo 4 - View of Road Culvert Immediately Downstream of Dam

Photo 5 - View of Discharge End of Outlet Pipe

Photo 6 - Close-up View of Discharge End of Outlet Pipe

Note: Photographs were taken on 30 March 1981.


6' STEEL PIPE
ROAD
OV-BOTTOM
3
5
4
TRAILER PAD
6
END SILL
OUTLET STRUCTURE
2
SPILLWAY
SUBMERGED INTAKE STRUCTURE
1+50
2+00
CUT OFF WALL
0+50
FOOT BRIDGE
OV-TOP
RESERVIOR
1
PHOTOGRAPH LOCATION PLAN
LAKE TIMBERLINE DAM
NDI NO. PA 00977
PennDER NO. 58-125
Photographs Taken 30 March 1981

LAKE TIMBERLINE DAM

PHOTO 1. View of Entrance to Spillway

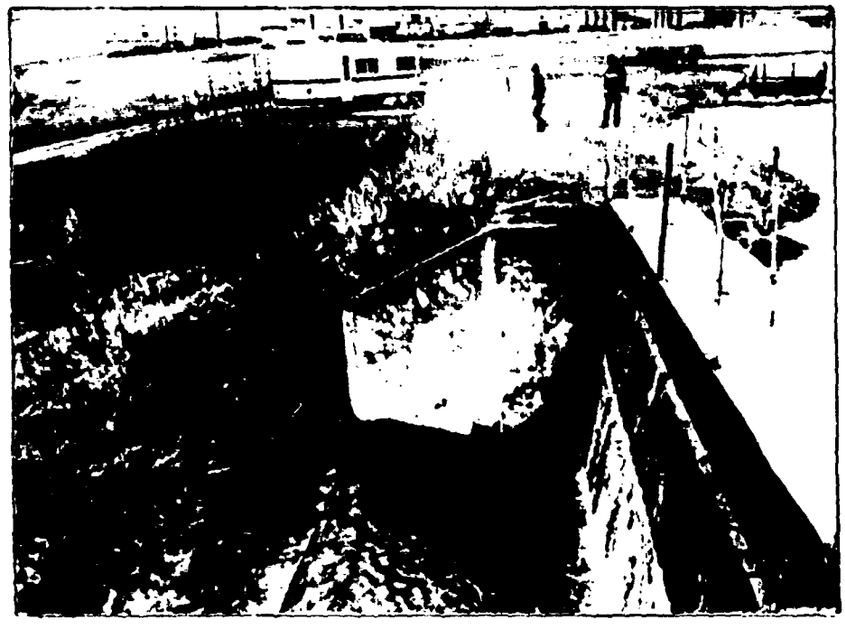


PHOTO 2. View Across Spillway

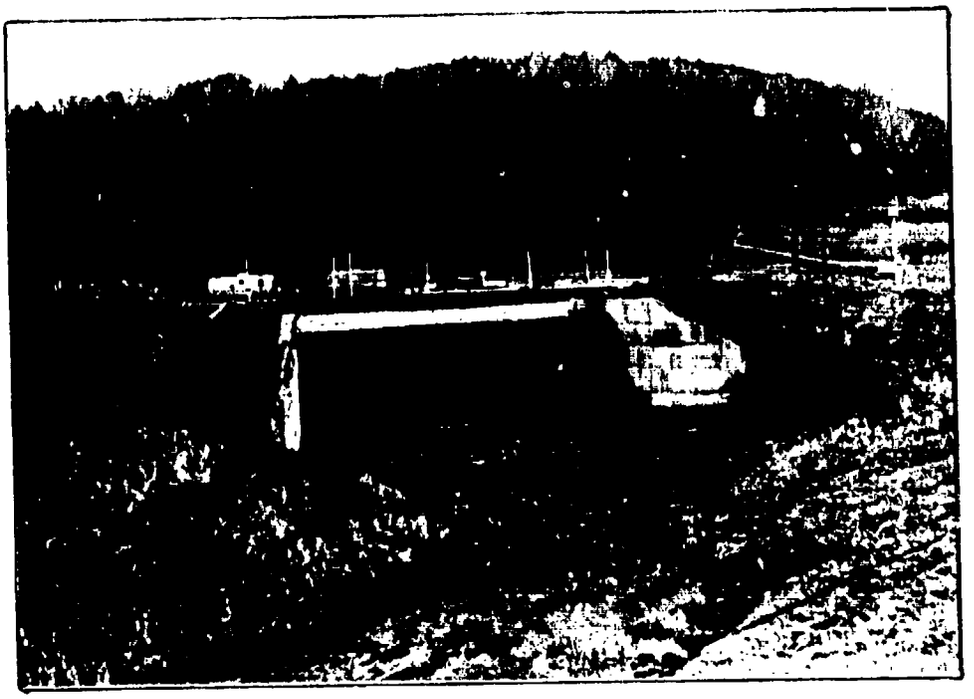


PHOTO 3. View of Downstream Side of Spillway

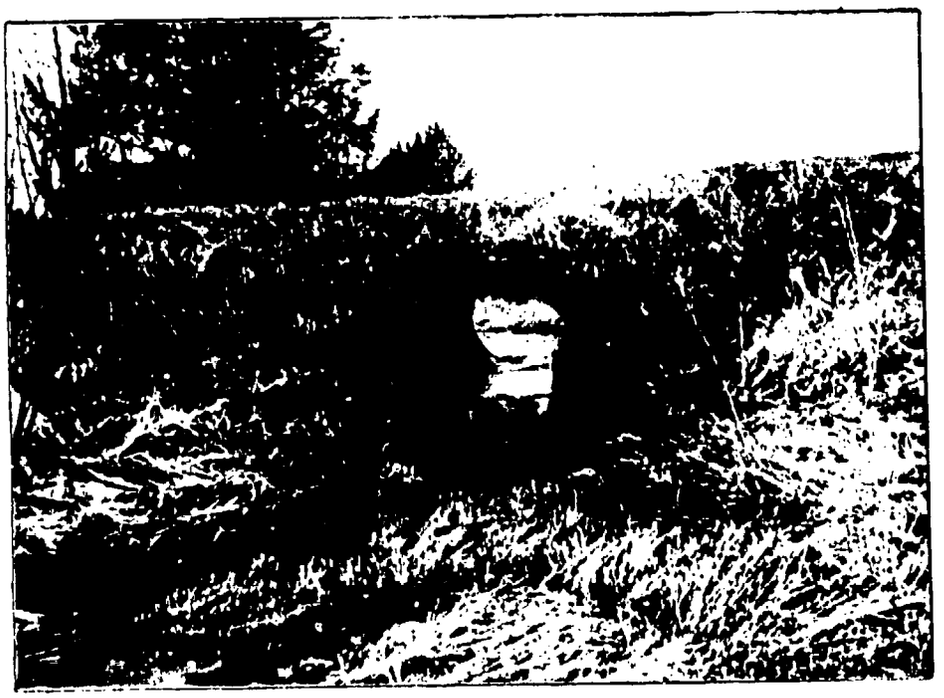


PHOTO 4. View of Road Culvert Immediately Downstream of Dam

PHOTO 5. View of Discharge End of Outlet Pipe

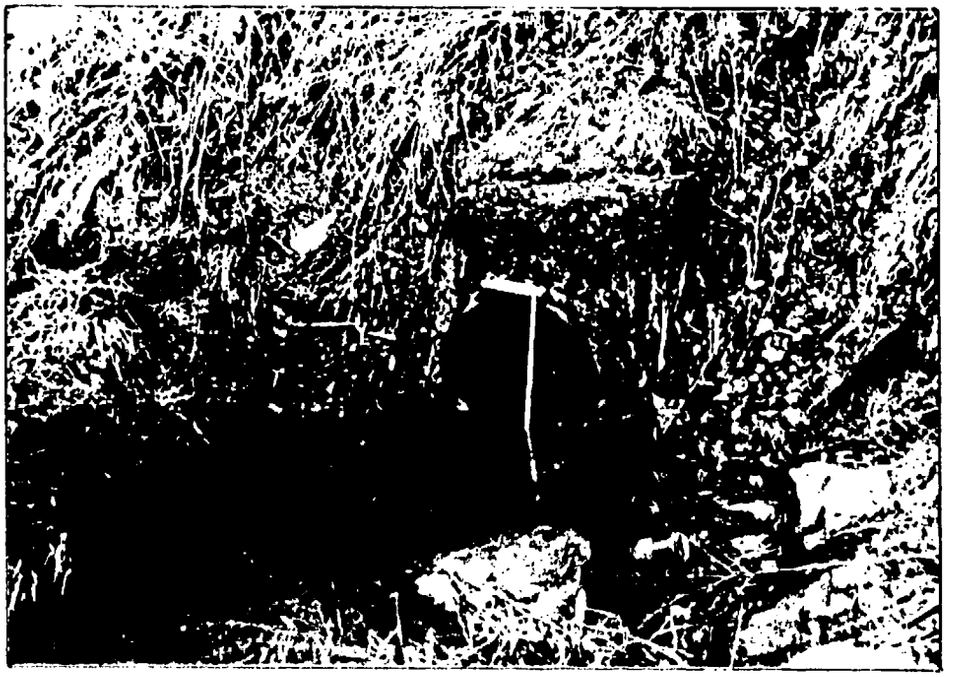


PHOTO 6. Close-up View of Discharge End of Outlet Pipe

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject LAKE TIMBERLINE DAM S.O. No. _____
APPENDIX D - HYDROLOGIC AND Sheet No. _____ of _____
HYDRAULIC CALCULATIONS Drawing No. _____
Computed by GWT Checked by _____ Date _____

SUBJECT	PAGE

PREFACE

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

Conclusions presented herein pertain to present conditions. The effect of future development on the hydrology of the watershed has not been considered.

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject Pa. Dam Insp. S.O. No.
Lake TIMBERLINE DAM Sheet No. 1 of 6
HYDRAULIC DATA Drawing No.
Computed by GBD Checked by GWT Date 4/8/81

DRAINAGE AREA

LAUREL LAKE QUAD. - $2451.3/3$ = 817.1 Acres = 1.28 mi^2

SURFACE AREAS

LAKE SURFACE @ El. 1417 - $0.69/3$ = 0.23 in^2 = 21.12 Acres = .033 mi
El. 1420 - $1.20/3$ = 0.40 in^2 = 36.73 Acres = .057 mi
El. 1440 - $1.98/3$ = 0.66 in^2 = 60.61 Acres = .094 mi^2

WATERSHED LENGTHS

L = 7,867.2 ft. = 1.49 mi.
Lc = 2,481.6 ft. = 0.47 mi.

NORMAL POOL STORAGE

$$\text{STORAGE VOLUME} = h/3\,(A_1 + A_2 + \sqrt{A_1 A_2})$$

$A_1 = 19.6$ Ac.
$A_2 = 21.12$ Ac.
$h = 7$

$$V = 7/3\,(19.6 + 21.12 + \sqrt{(19.6)21.12})$$

$V = 142$ Ac-Ft

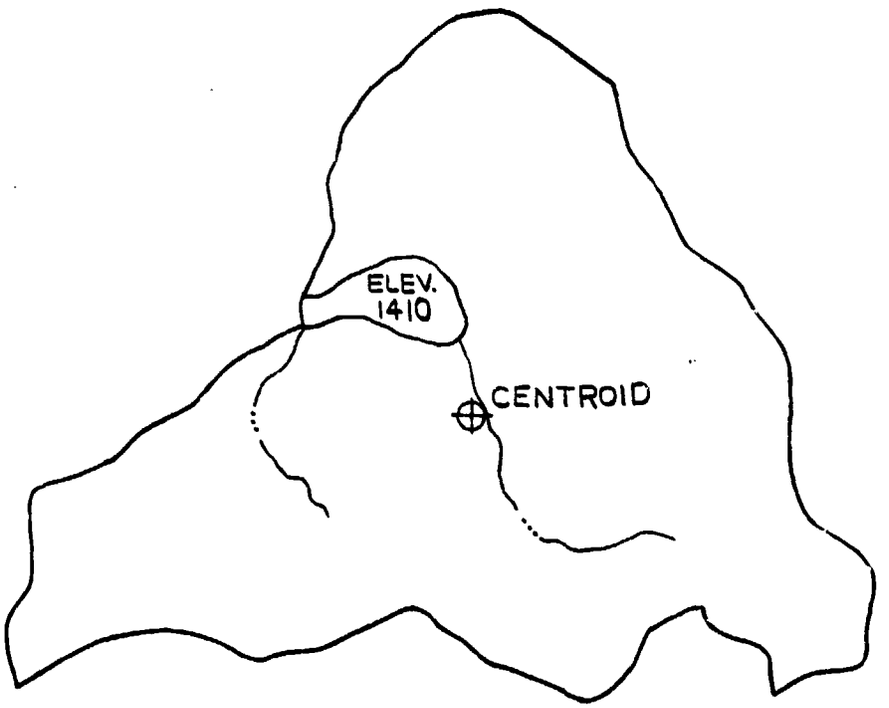
TOP OF DAM STORAGE

$$\text{STORAGE VOLUME} = h/3\,(A_1 + A_2 + \sqrt{A_1 A_2})$$

$A_1 = 19.6$ Ac
$A_2 = 22.7$ Ac.
$h = 8.6$ Ft

$$V = 8.6/3\,(19.6 + 22.7 + \sqrt{(19.6)22.7})$$

$V = 182$ Ac-Ft



LAUREL LAKE QUAD.

LAKE TIMBERLINE DAM

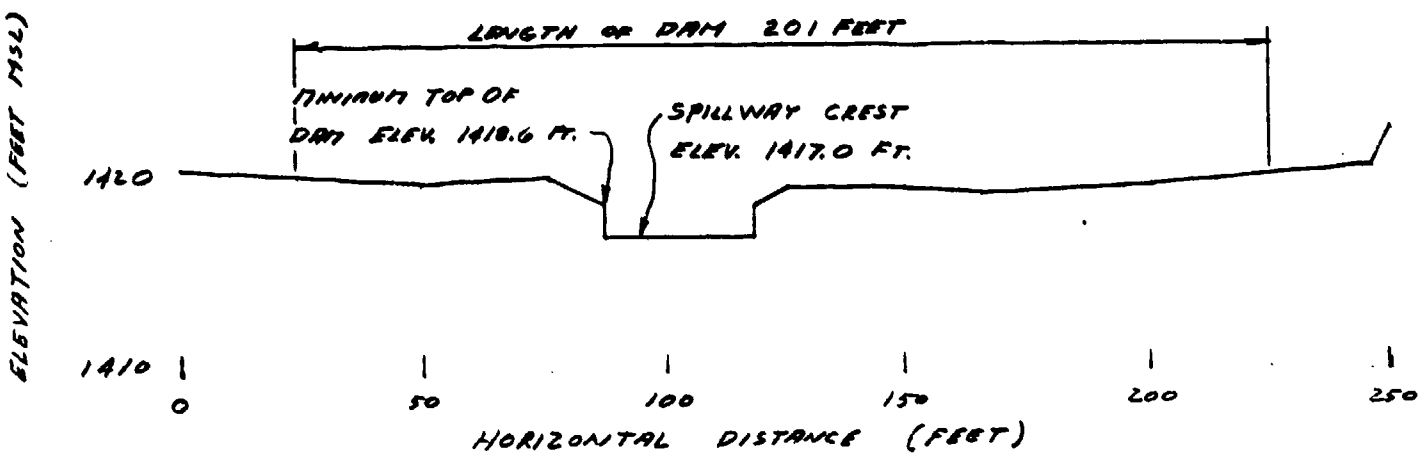
DRAINAGE AREA AND CENTROID MAP

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

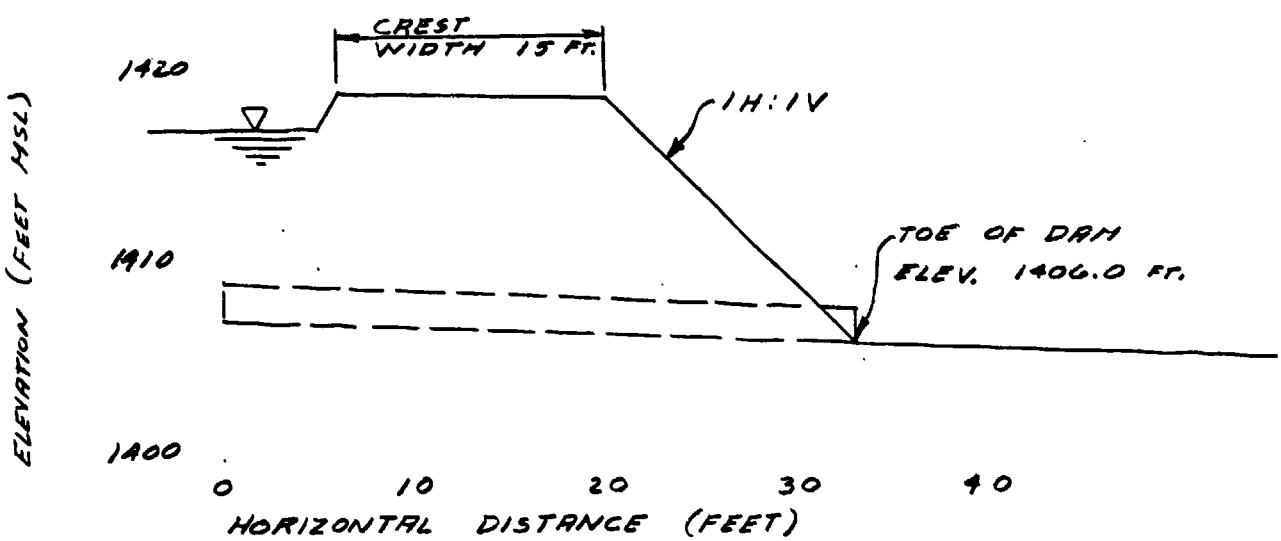
Box 280
Beaver, Pa. 15009

Subject LAKE TIMBERLINE DAM — S.O. No. ____
TOP OF DAM PROFILE AND — Sheet No. 3 of 6
TYPICAL CROSS SECTION — Drawing No. ____
Computed by GWT — Checked by WBL — Date 3-30-01

TOP OF DAM PROFILE (LOOKING DOWNSTREAM)



TYPICAL CROSS SECTION @ STATION 1+65

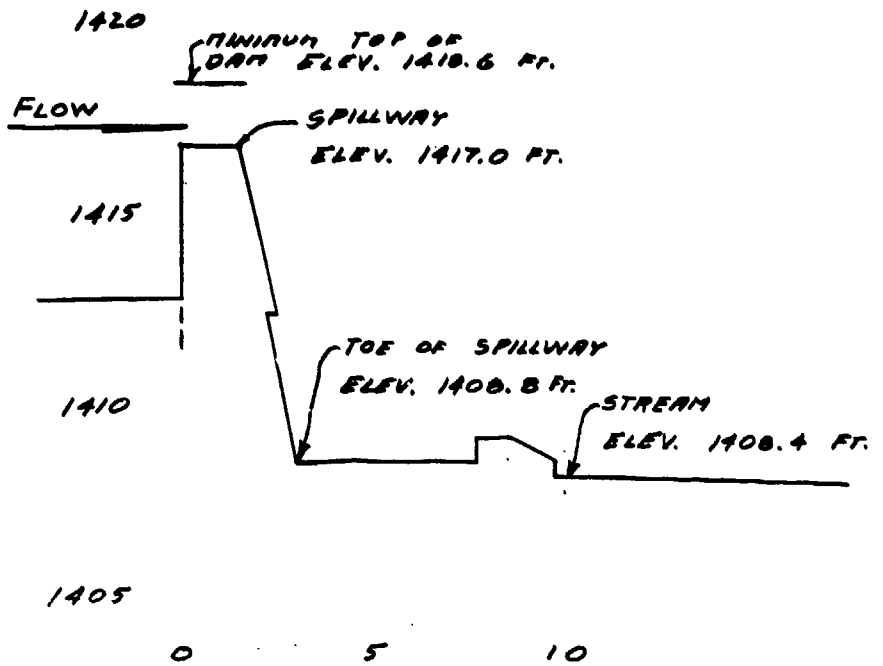


MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject LAKE TIMBERLINE DAM — S.O. No.
SPILLWAY DISCHARGE RATING — Sheet No. 4 of 6
Drawing No.
Computed by GWT — Checked by WDV — Date 3-30-91

SPILLWAY PROFILE



SPILLWAY DISCHARGE RATING

$Q = CLH^{3/2}$

$C = 3.1$ FROM BRATER & KING TABLE 5-3 PAGE 5-40

$L = 30.7$ FEET

H VARIES

SPILLWAY CAPACITY AT THE MINIMUM TOP OF DAM

$Q = 3.1\ (30.7)(1.6)^{3/2}$

$Q = 193$ C.F.S.

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject LAKE TIMBERLINE DAM S.O. No.
100-YEAR DISCHARGE CALCULATIONS Sheet No. 5 of 6
Drawing No.
Computed by GWT Checked by WDV Date 4/7/81

THE INFLOW TO THE IMPOUNDMENT FOR THE 100-YEAR FLOOD WAS CALCULATED USING MATERIAL FROM "THE HYDROLOGIC STUDY - TROPICAL STORM AGNES" PREPARED BY THE SPECIAL STUDIES BRANCH, PLANNING DIVISION, NORTH ATLANTIC DIVISION, CORPS OF ENGINEERS, IN NEW YORK CITY.

DRAINAGE AREA - 1.28 Sq. Mi.

① COMPUTE THE MEAN LOGARITHM

$LOG(Q_m) = C_m + 0.75 \, LOG A$

$LOG(Q_m)$ = MEAN LOGARITHM OF ANNUAL FLOOD PEAKS
A = DRAINAGE AREA, SQ. MI. = 1.28
C_m = MAP COEFFICIENTS FOR MEAN LOG OF ANNUAL PEAKS FROM FIG. 21 - 2.20

$LOG(Q_m) = 2.20 + 0.75 (LOG\ 1.28)$
$= 2.2804$

② COMPUTE STANDARD DEVIATION

$S = C_s - 0.05 (LOG A)$

S = STANDARD DEVIATION OF THE LOGARITHMS OF THE ANNUAL PEAKS.
C_s = MAP COEFFICIENT FOR STANDARD DEVIATION FROM FIG. 22 = 0.35
A = DRAINAGE AREA, SQ. MI., = 1.28

$S = 0.35 - 0.05 (LOG\ 1.28)$
$= 0.3446$

③ SELECT SKEW COEFFICIENT FROM FIG. 23 = 0.225

④ $LOG(Q_{100}) = LOG(Q_m) + K(P,g) S$

K(P,g) = STANDARD DEVIATE FOR A GIVEN EXCEEDENCE FREQUENCY PERCENTAGE (P) AND SKEW COEFFICIENT (g) FROM EXHIBIT 39 OF BEARD'S "STATISTICAL METHODS IN HYDROLOGY"

$LOG(Q_{100}) = 2.2804 + 2.50(0.3446)$
$Q_{100} = 1,386$ CFS

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject LAKE TIMBERLINE DAM S.O. No.
100-YEAR DISCHARGE CALCULATION Sheet No. 6 of 6
Drawing No.
Computed by GWT Checked by WDV Date 7/10/81

THE INFLOW TO THE IMPOUNDMENT FOR THE 100-YEAR FLOOD WAS CALCULATED USING MATERIAL FROM "WATER RESOURCES BULLETIN, BULLETIN NO. 13, FLOODS IN PENNSYLVANIA", PREPARED BY THE DEPARTMENT OF ENVIRONMENTAL RESOURCES, COMMONWEALTH OF PENNSYLVANIA.

DRAINAGE BASIN FROM PLATE 1 – MODEL 2

REGRESSION EQUATION FROM TABLE

$Q_T = CA^x$

T = 100 YEARS
C = 564
A = DRAINAGE AREA, 1.28 Sq. Mi.
x = .744

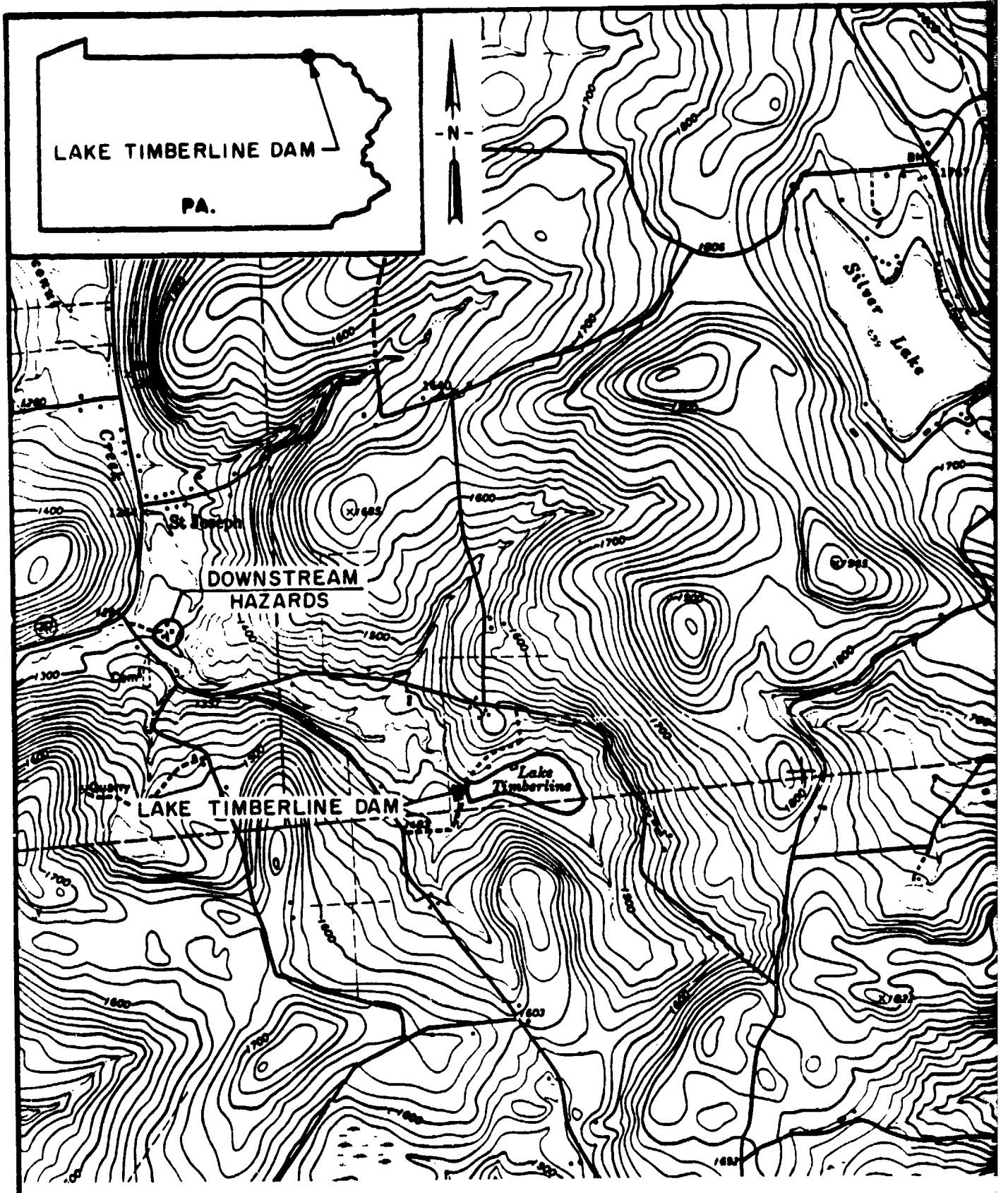
$Q_{100} = 564\ (1.28)^{.744}$
$Q_{100} = 678$ C.F.S.

AVERAGING THE INFLOW FROM THIS METHOD AND THE PREVIOUS METHOD GIVES AN INFLOW OF 1,030 C.F.S. TO THE IMPOUNDMENT.

APPENDIX E

PLATES

CONTENTS



SCALE 1:24000

1 MILE

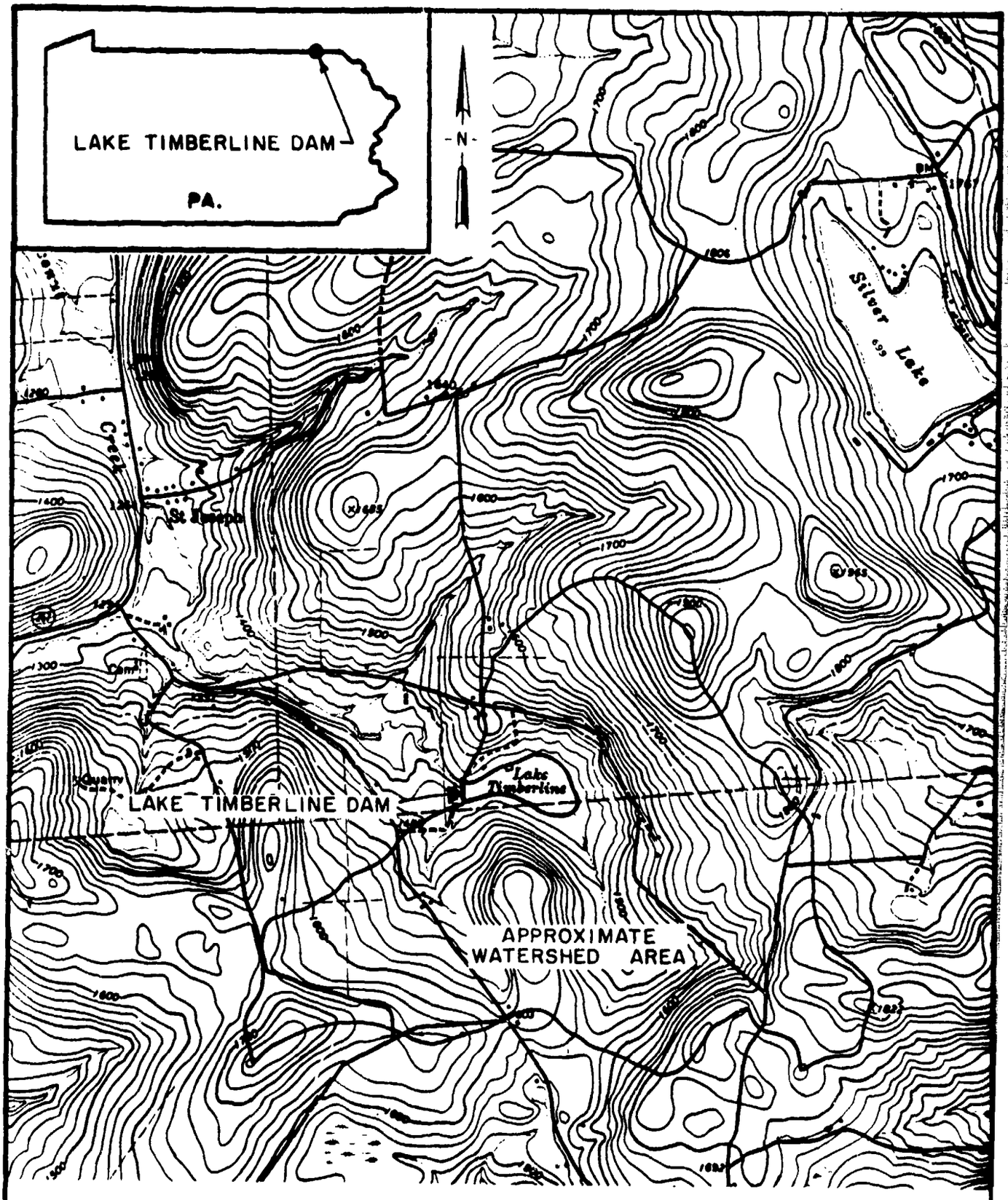
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 0 1 KILOMETER

PLATE 1 LOCATION PLAN

LAKE TIMBERLINE DAM

REFERENCES:
1. U.S.G.S. 7.5' LAUREL LAKE, PA.-N.Y. QUADRANGLE. 1968



SCALE 1:24000

1 0 1 MILE

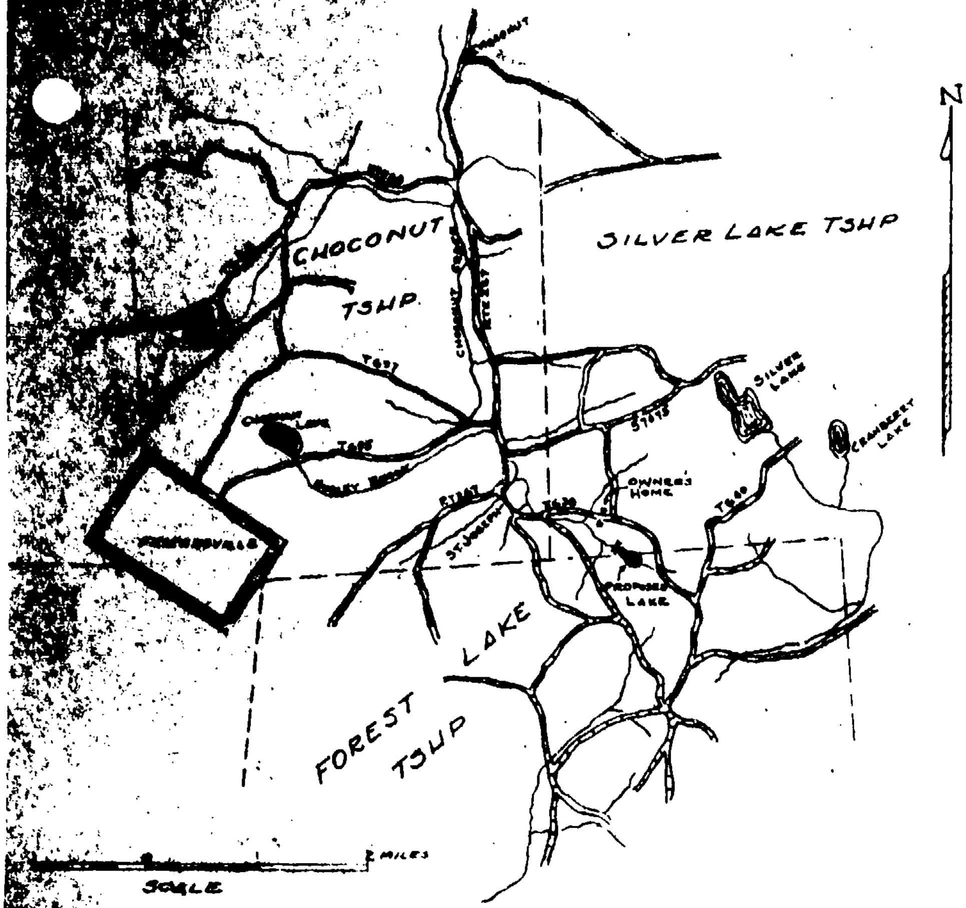
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

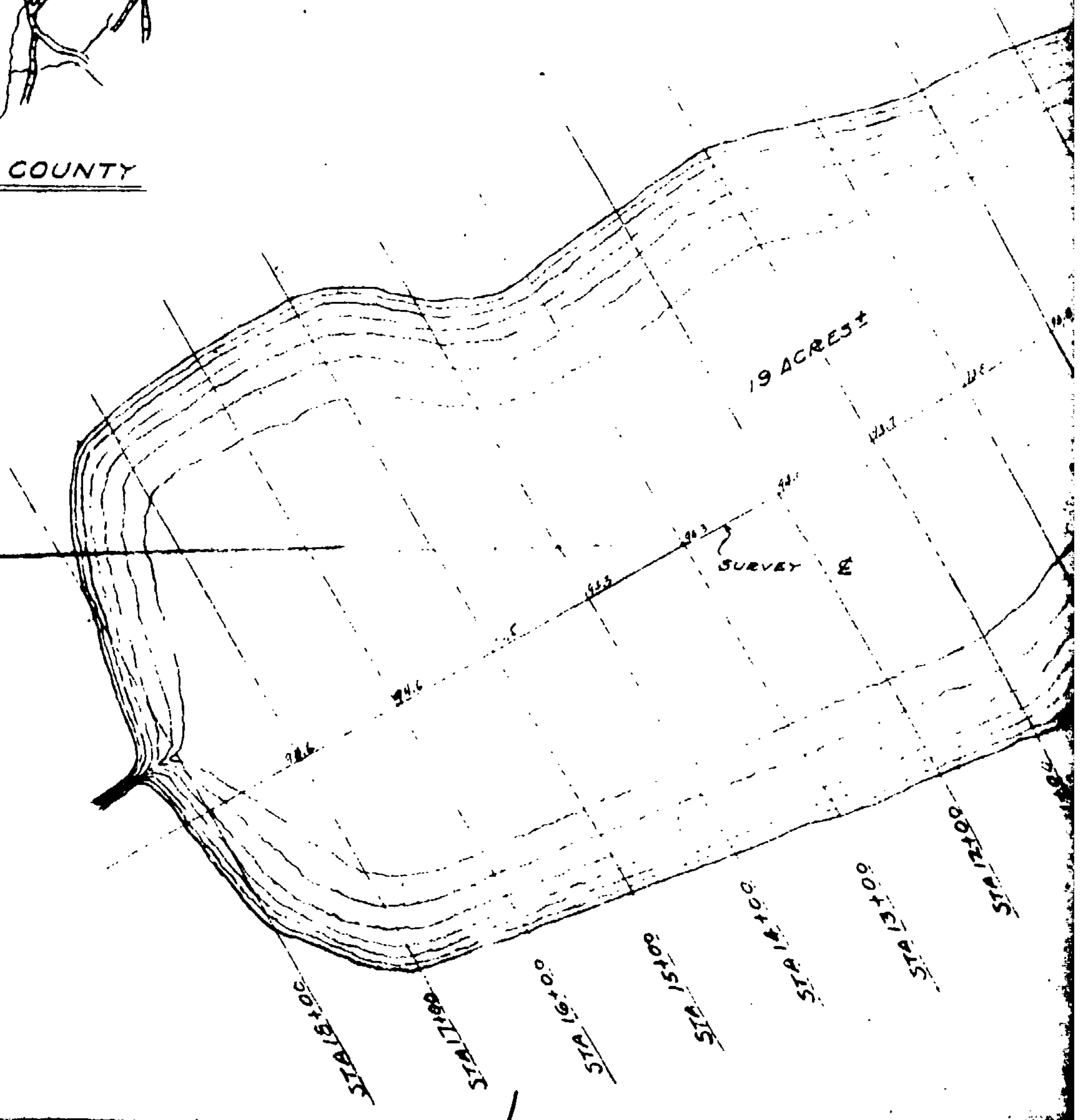
PLATE 2 WATERSHED MAP

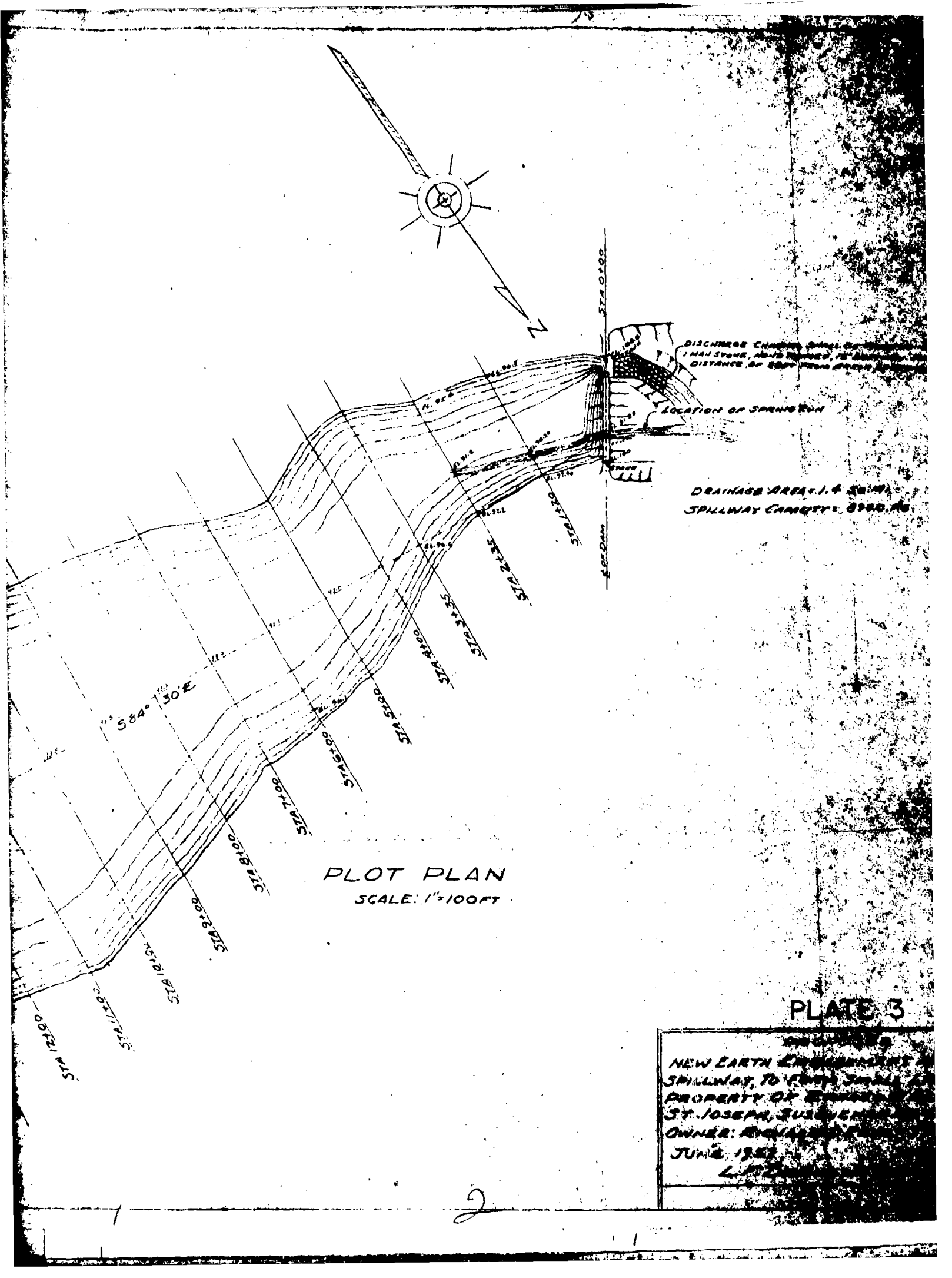
LAKE TIMBERLINE DAM

REFERENCES:
1. U.S.G.S. 7.5' LAUREL LAKE, PA.-N.Y. QUADRANGLE. 1968



SUSQUEHANNA COUNTY



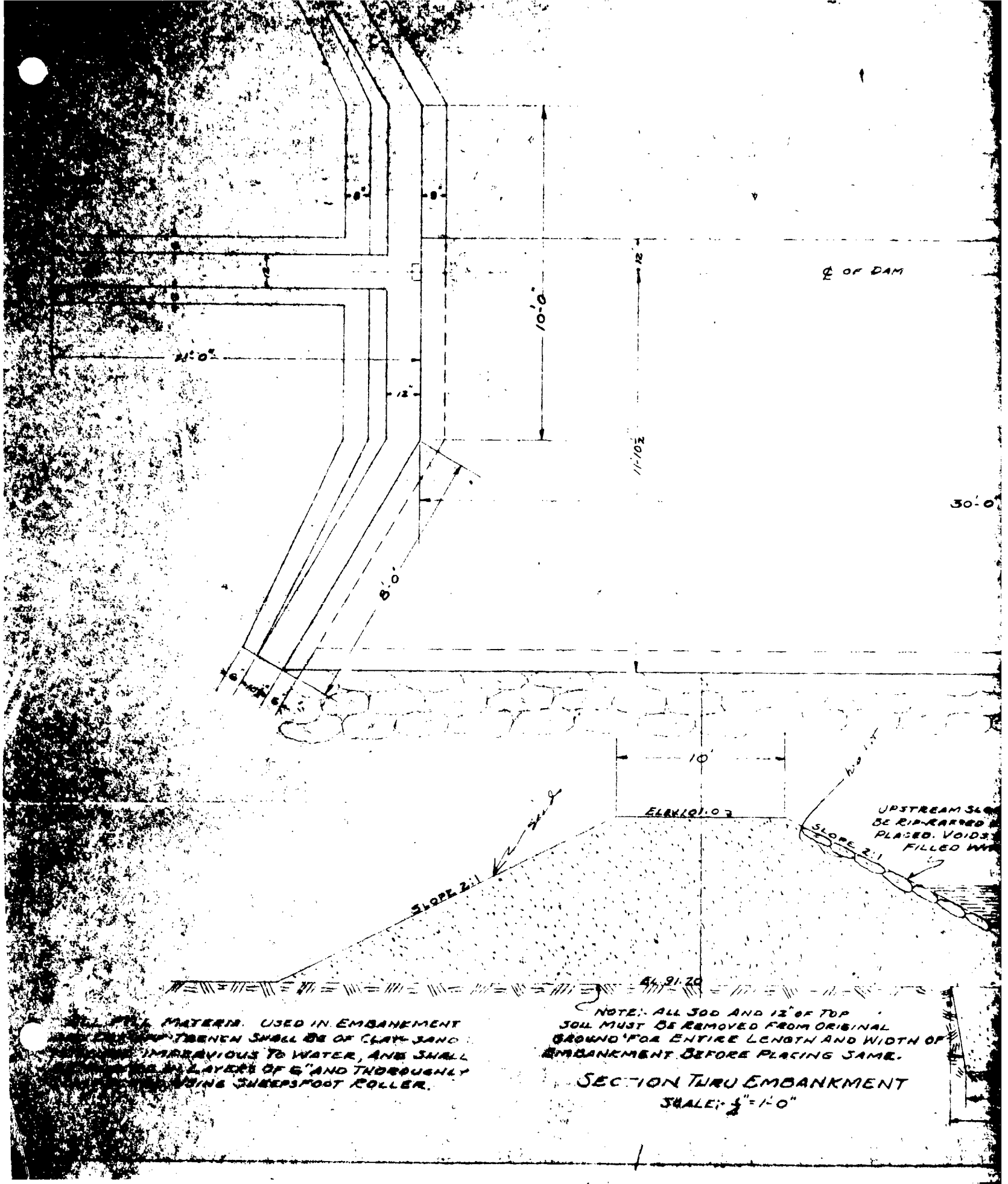


PLOT PLAN

SCALE: 1" = 100 FT

PLATE 3

NEW EARTH
SPILLWAY, TO
PROPERTY OF
ST. JOSEPH,
OWNER:
JUNE 19



ALL FILL MATERIAL USED IN EMBANKMENT [illegible] SHALL BE OF CLAY-SAND [illegible] IMPERVIOUS TO WATER, AND SHALL [illegible] IN LAYERS OF 6" AND THOROUGHLY [illegible] USING SHEEPSFOOT ROLLER.

NOTE:- ALL SOD AND 12" OF TOP SOIL MUST BE REMOVED FROM ORIGINAL GROUND FOR ENTIRE LENGTH AND WIDTH OF EMBANKMENT BEFORE PLACING SAME.

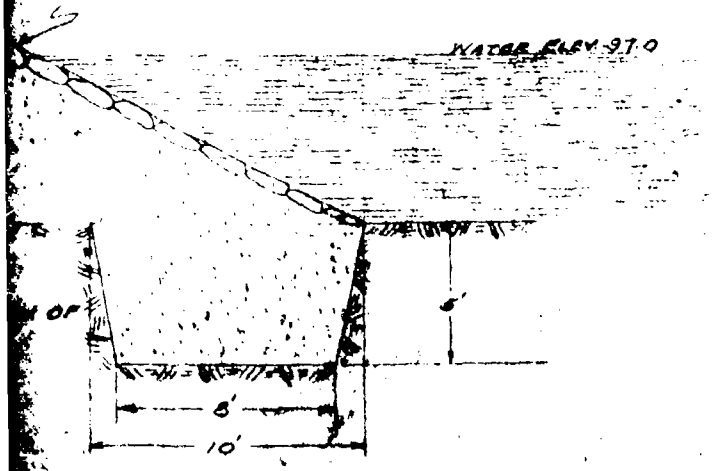
SECTION THRU EMBANKMENT

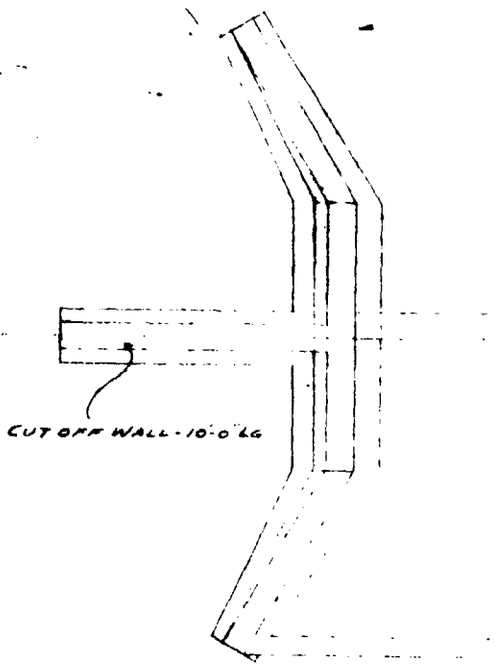
SCALE: ½" = 1'-0"

WAY

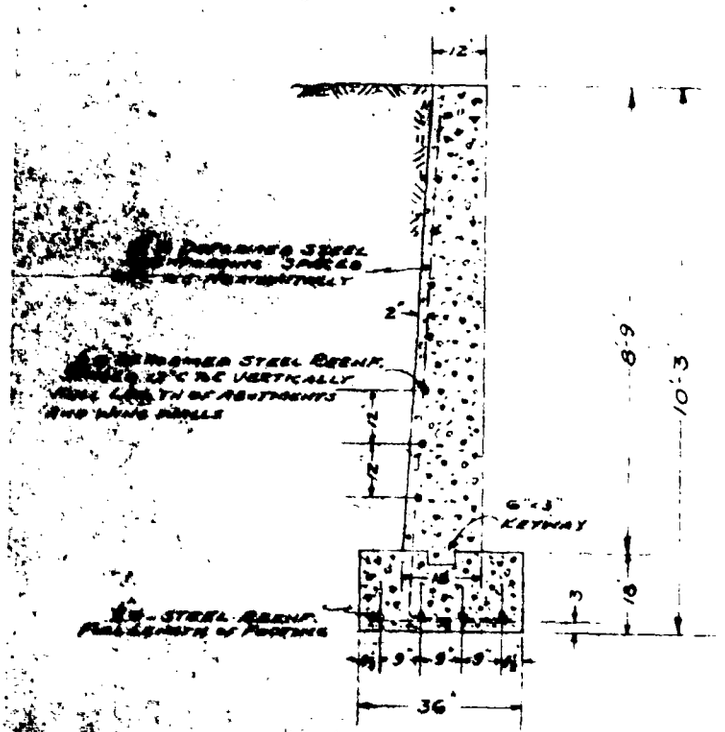
30'-0"

STREAM SLOPE OF EMBANKMENT SHALL BE RAPPED USING ONE MAN STONE, HAND ED. VOIDS BETWEEN STONES SHALL BE FILLED WITH CRACKED STONE

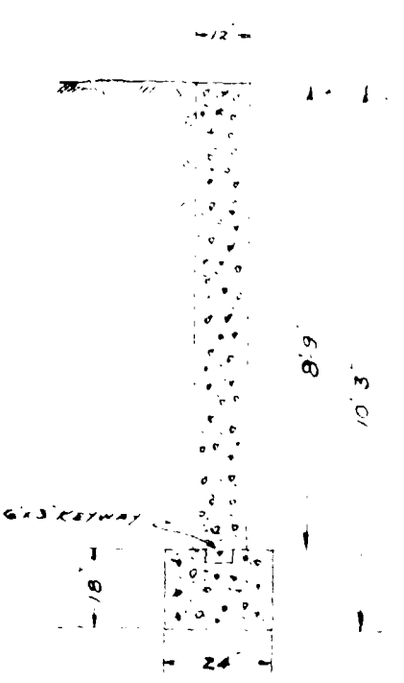




PLAN
3/16" = 1'-0"



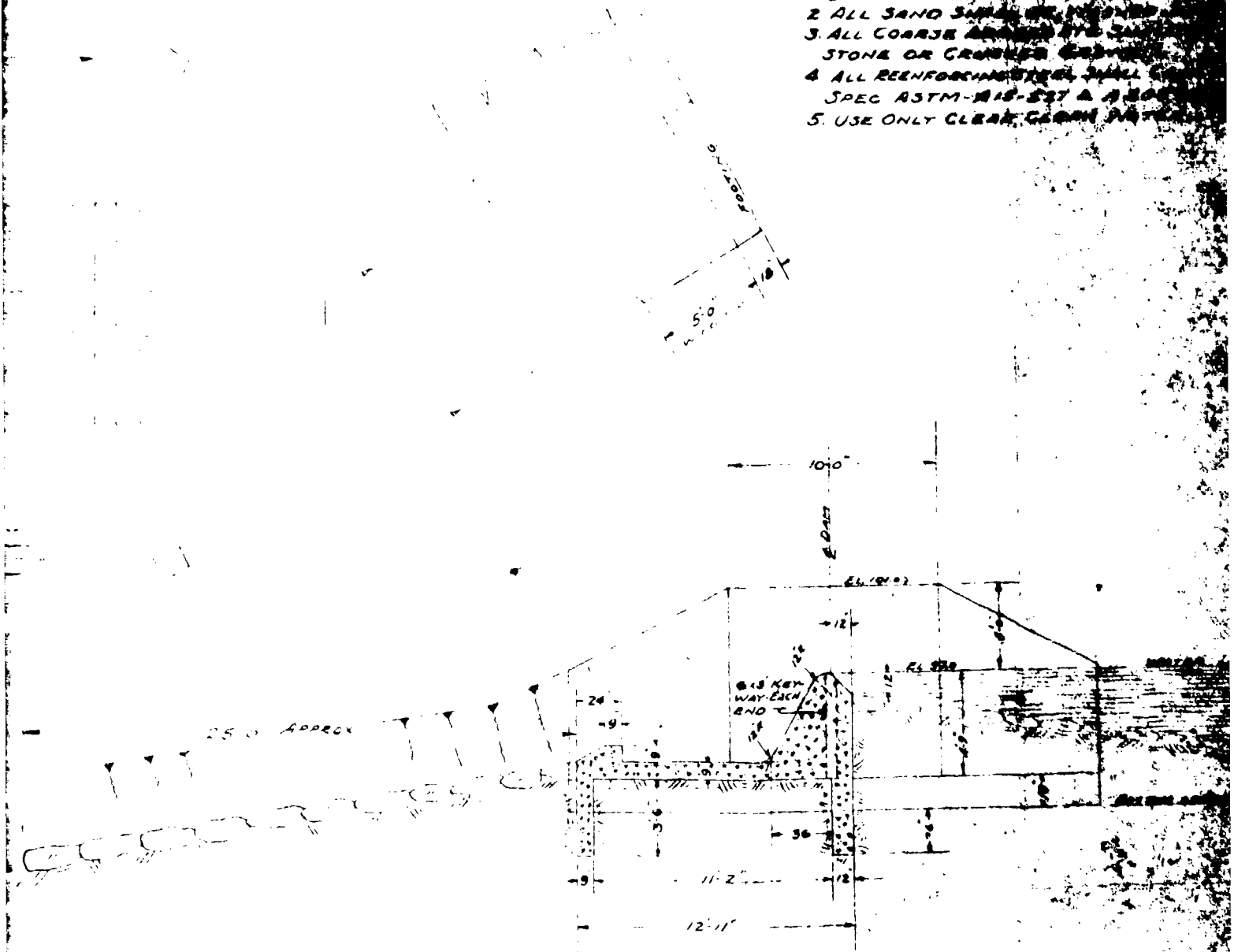
SECTION THRU ABUTMENT WALL
SCALE: 1/2" = 1'-0"



SECTION THRU CUT-OFF WALL
SCALE: 1/2" = 1'-0"

NOTES

1 ALL CONCRETE [illegible] BE 1:2:4 MIX.
2 ALL SAND SHALL [illegible]
3. ALL COARSE AGGREGATE [illegible] STONE OR GRAVEL [illegible]
4 ALL REINFORCING STEEL SHALL [illegible] SPEC ASTM-A15-53T A A [illegible]
5. USE ONLY CLEAN, [illegible]



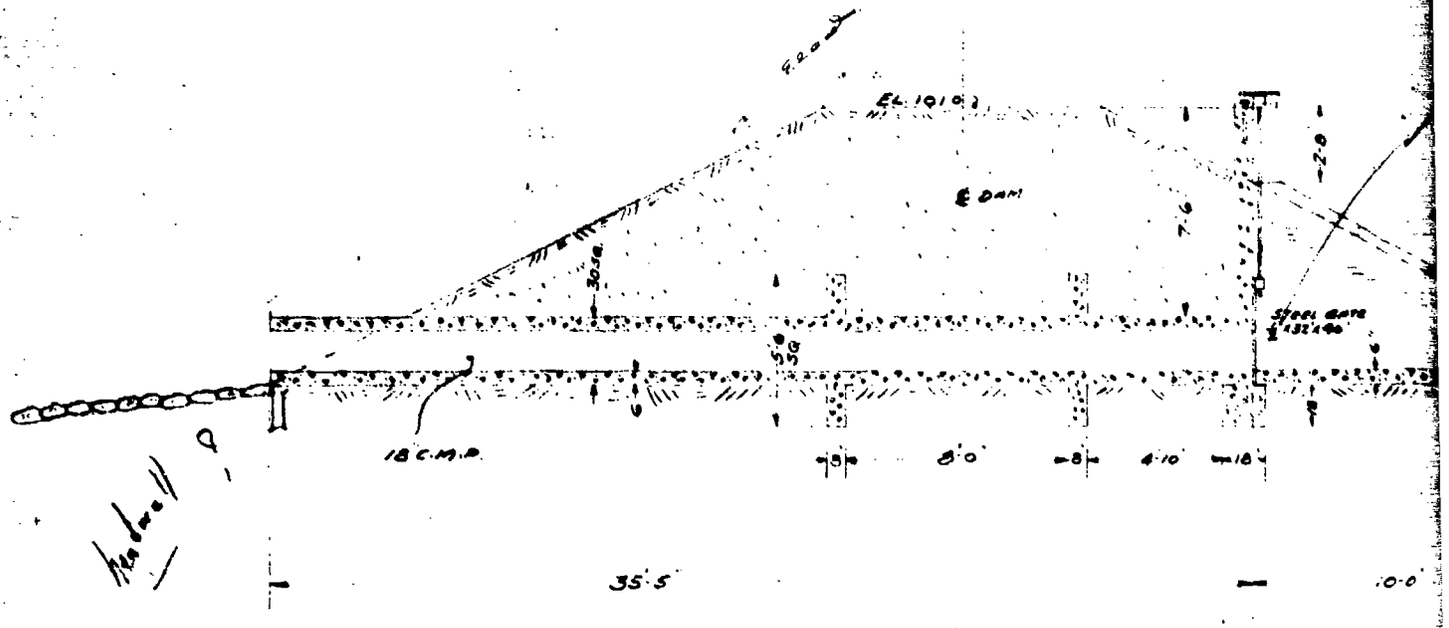
SECTION THRU SPILLWAY WEIR
SCALE: 1/4"=1'-0"

SPILLWAY DETAILS

PLATE 5

NEW DAM [illegible]
LAKE ON [illegible]
O'REILLY, [illegible]

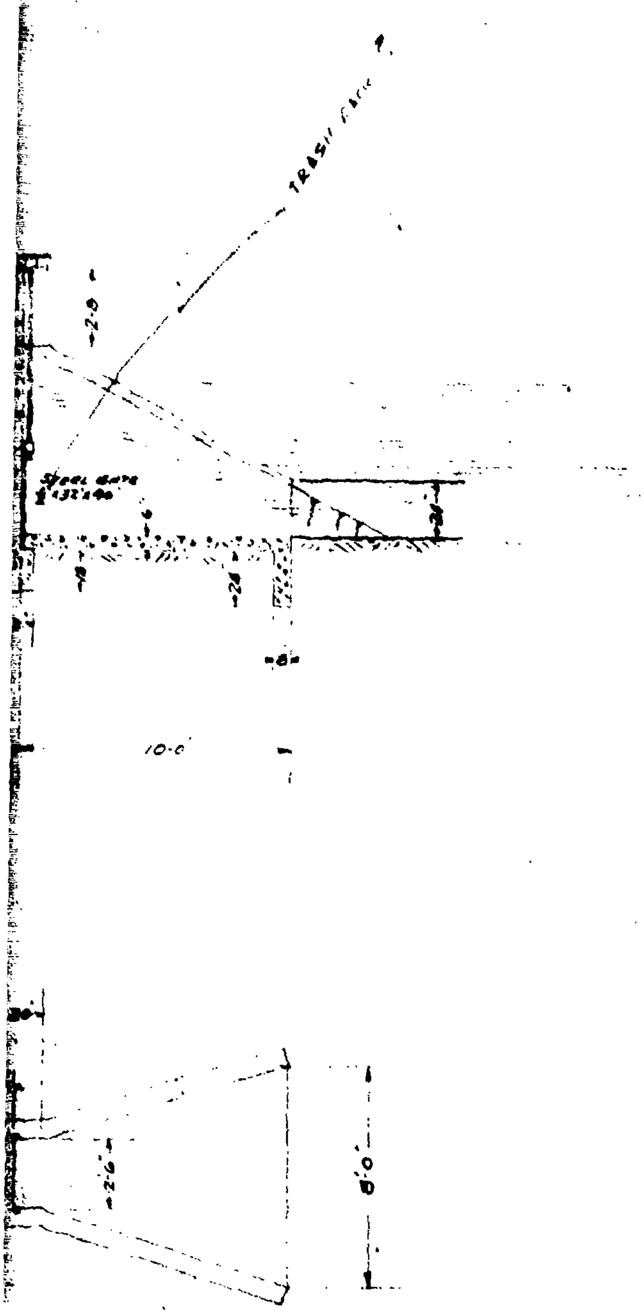
JUNE 19[illegible]



SECTION THRU EMBANKMENT

PLAN

DRA



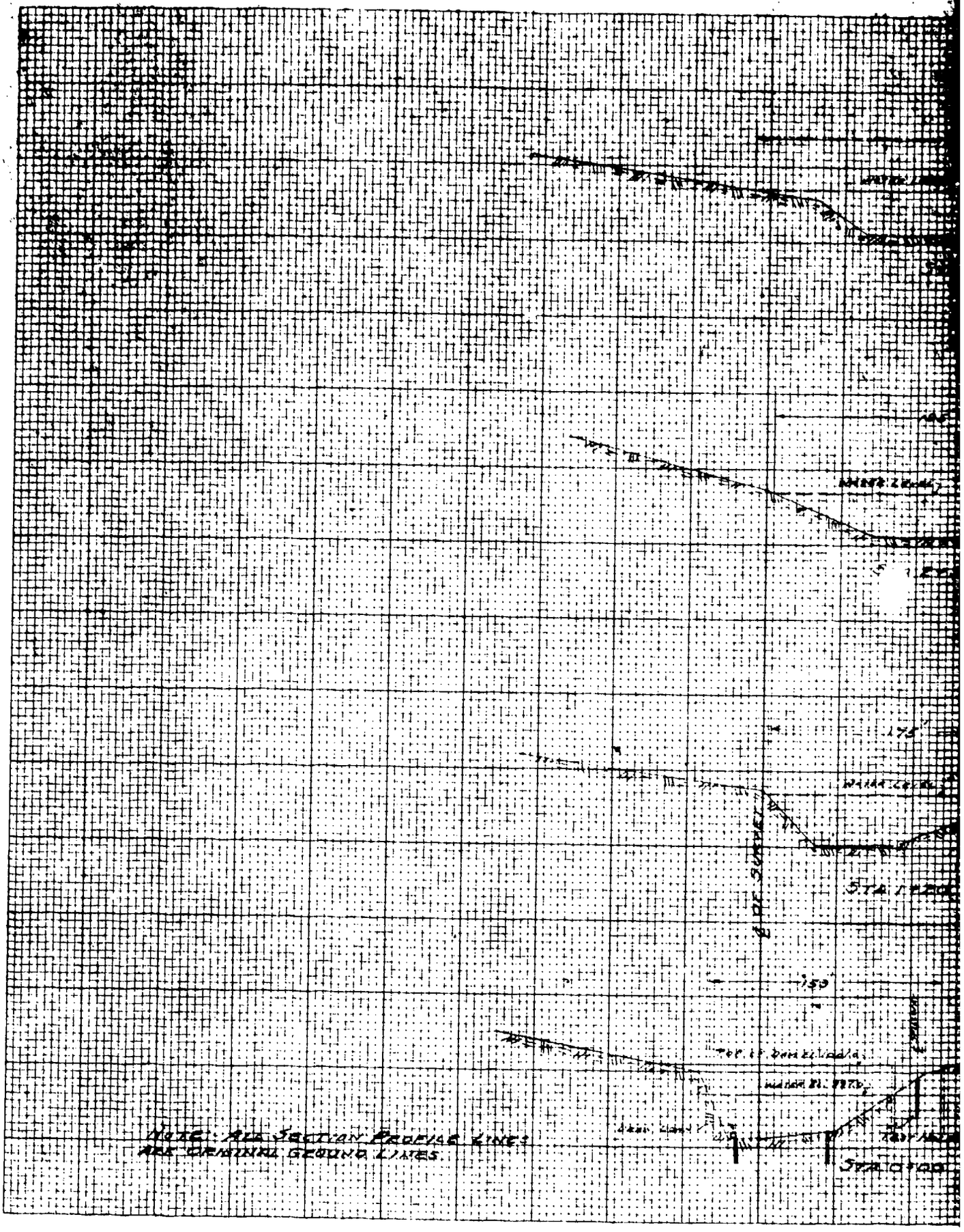
DRAW DOWN DETAILS

SCALE: 1/4" = 1'-0"

PLATE 6

PROPOSED
NEW DAM AND SPILLWAY
ON PROPERTY OF [illegible]
O'REILLY, [illegible]
[illegible]
JUNE 19[illegible]
[illegible]

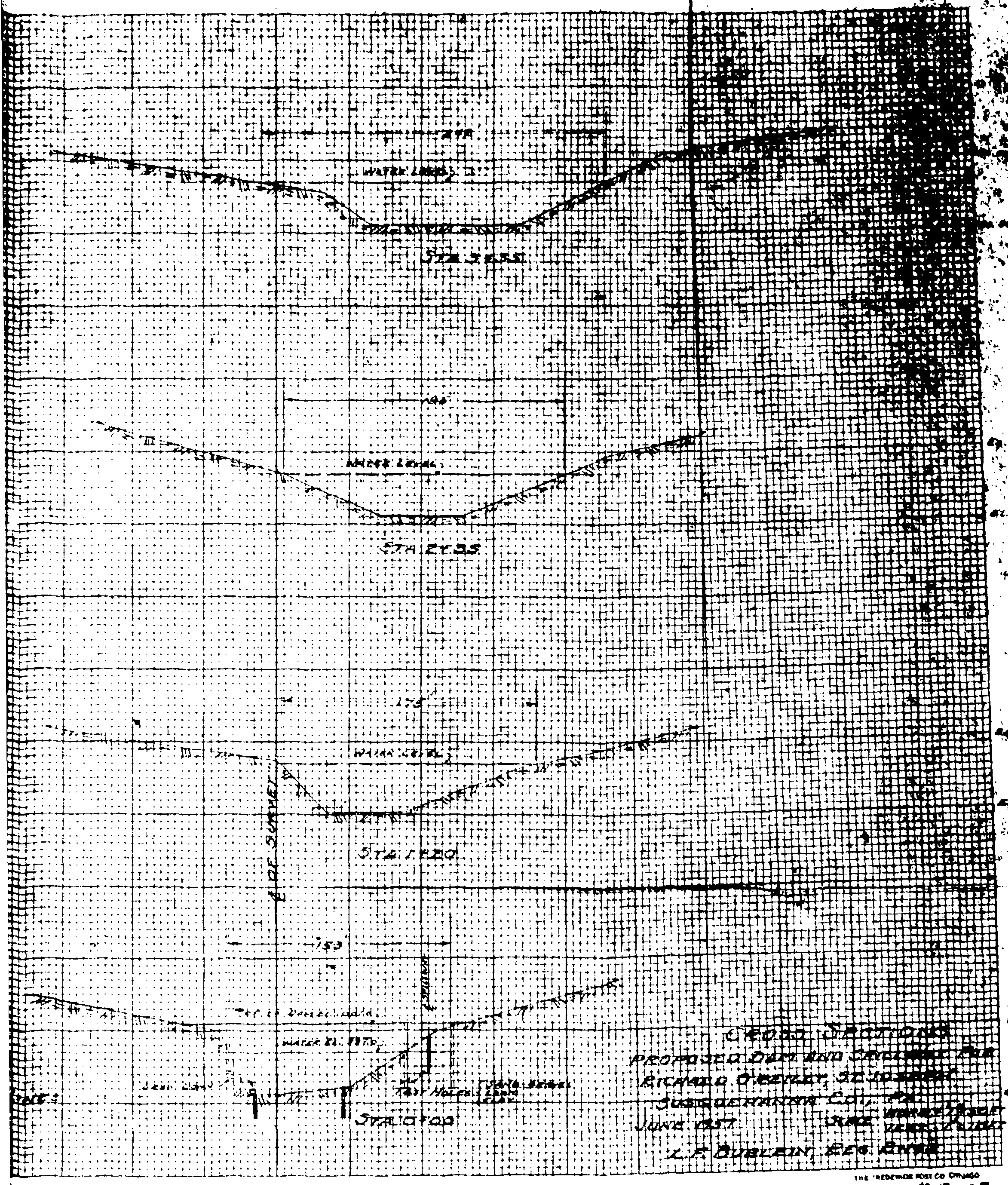
2



PREFERRED CROSS SECTION

10×10 TO ONE INCH

No. 503

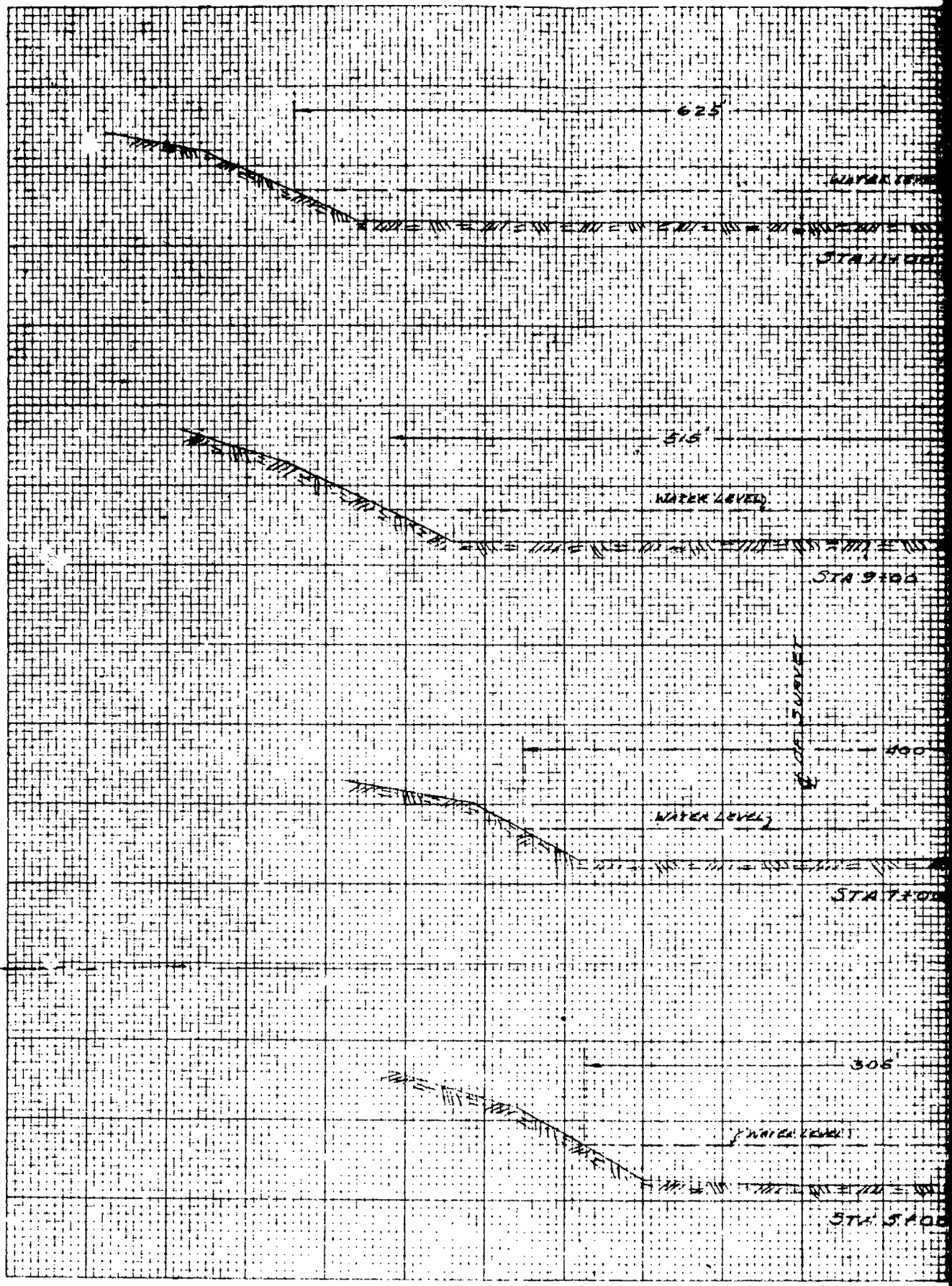


PREFERRED CROSS SECTION
10X10 TO ONE INCH
No. 503

THE FREDERICK POST CO CHICAGO

SHEET No 5 of 7

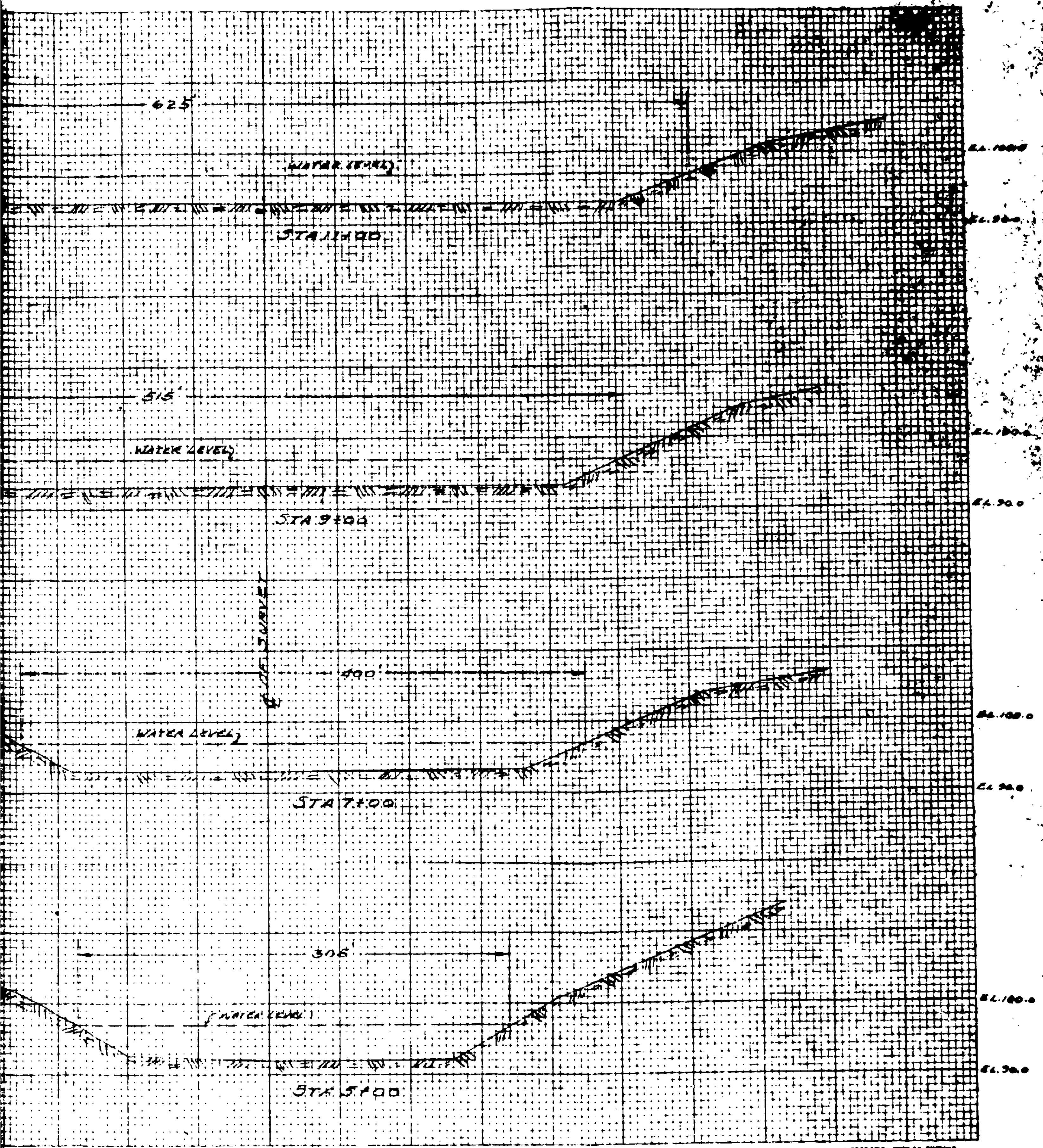
PLATE 7



PREFERRED CROSS SECTION

10*10 TO ONE INCH

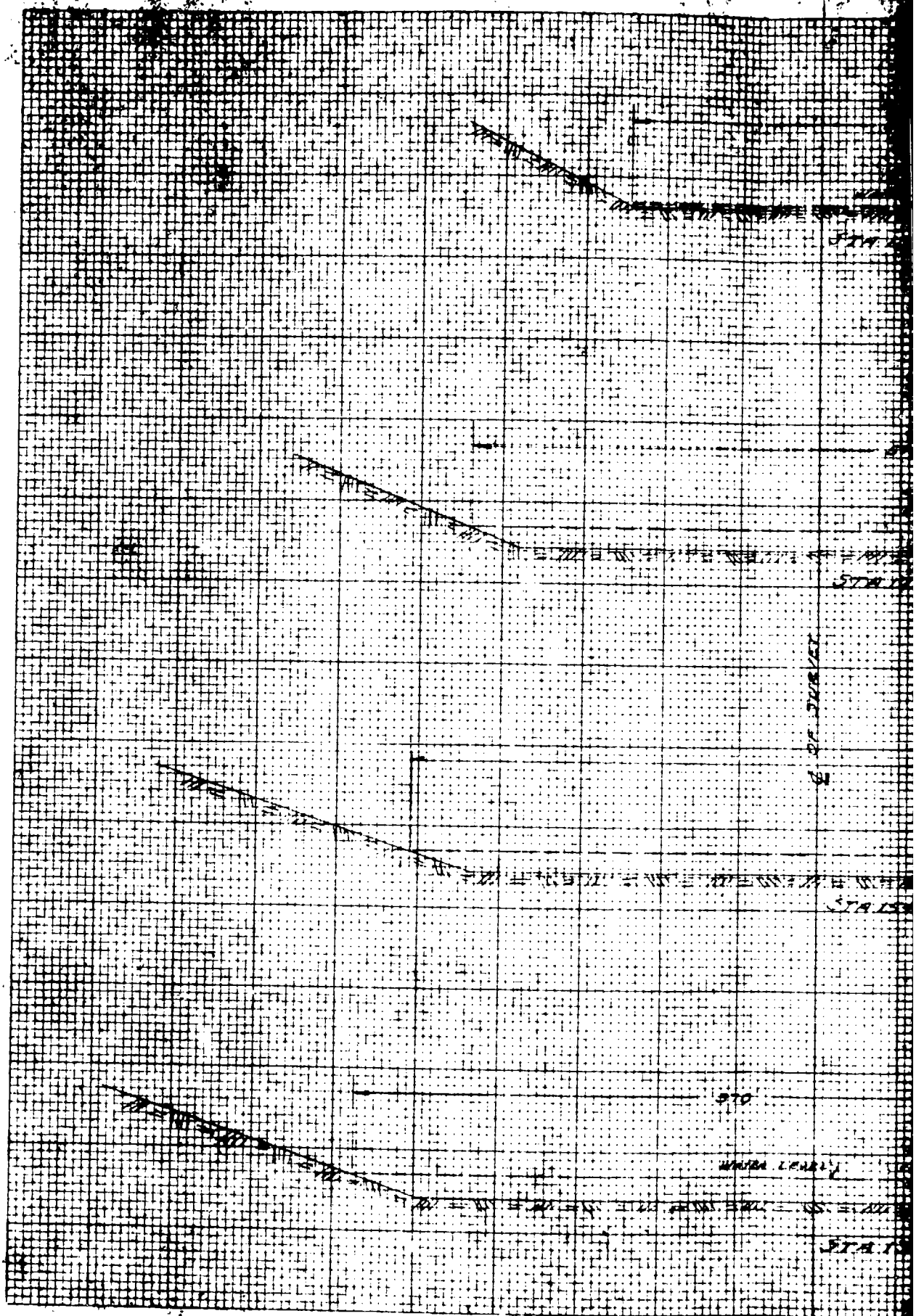
No 503



PREFERRED CROSS SECTION
10 X 10 TO ONE INCH
No 503

SHEET No 6 of 7

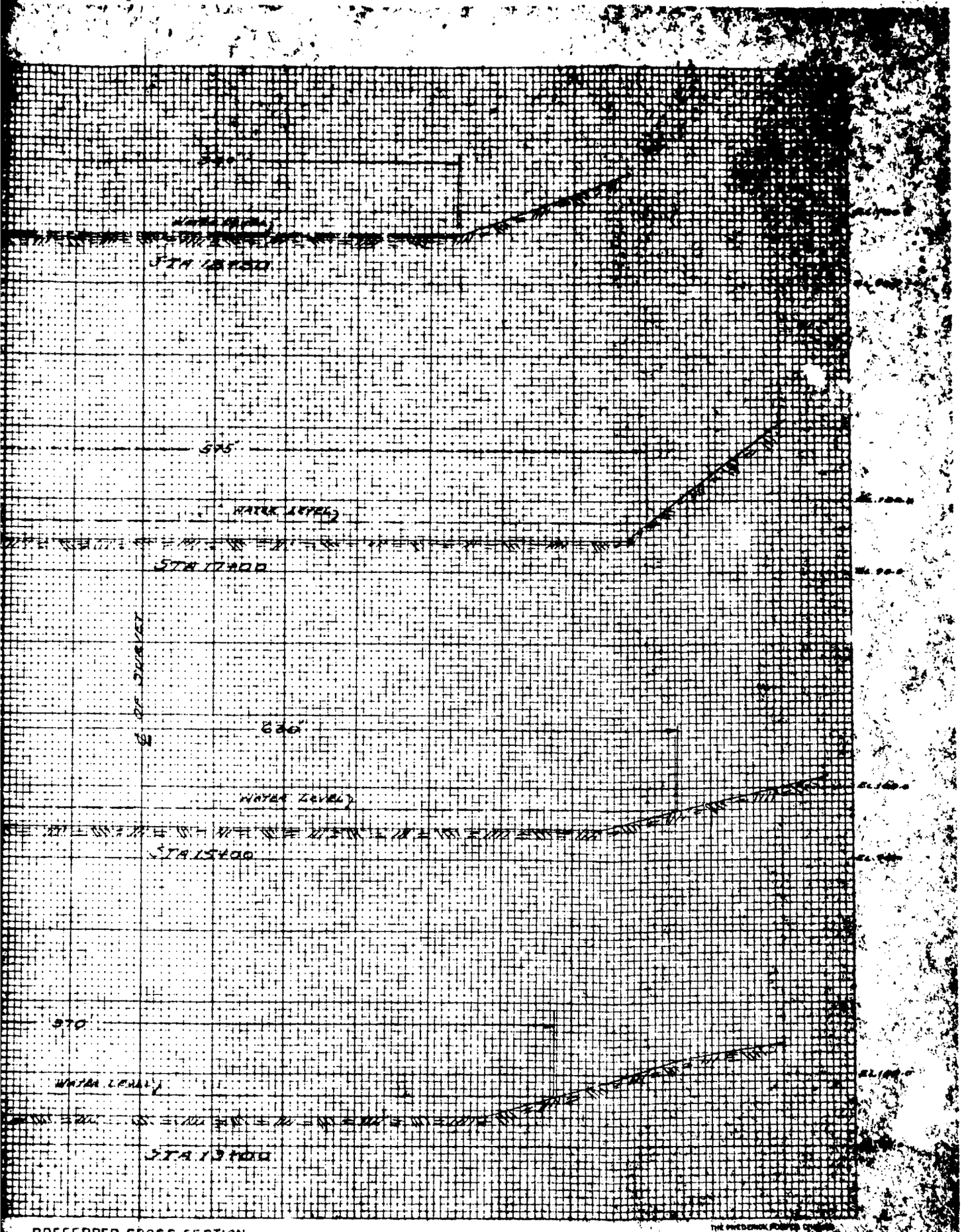
PLATE 8



PREFERRED CROSS SECT

10 * 10 TO ONE INCH

No. 989



PREFERRED CROSS SECTION
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No. 583

PLATE 9

APPENDIX F

REGIONAL GEOLOGY

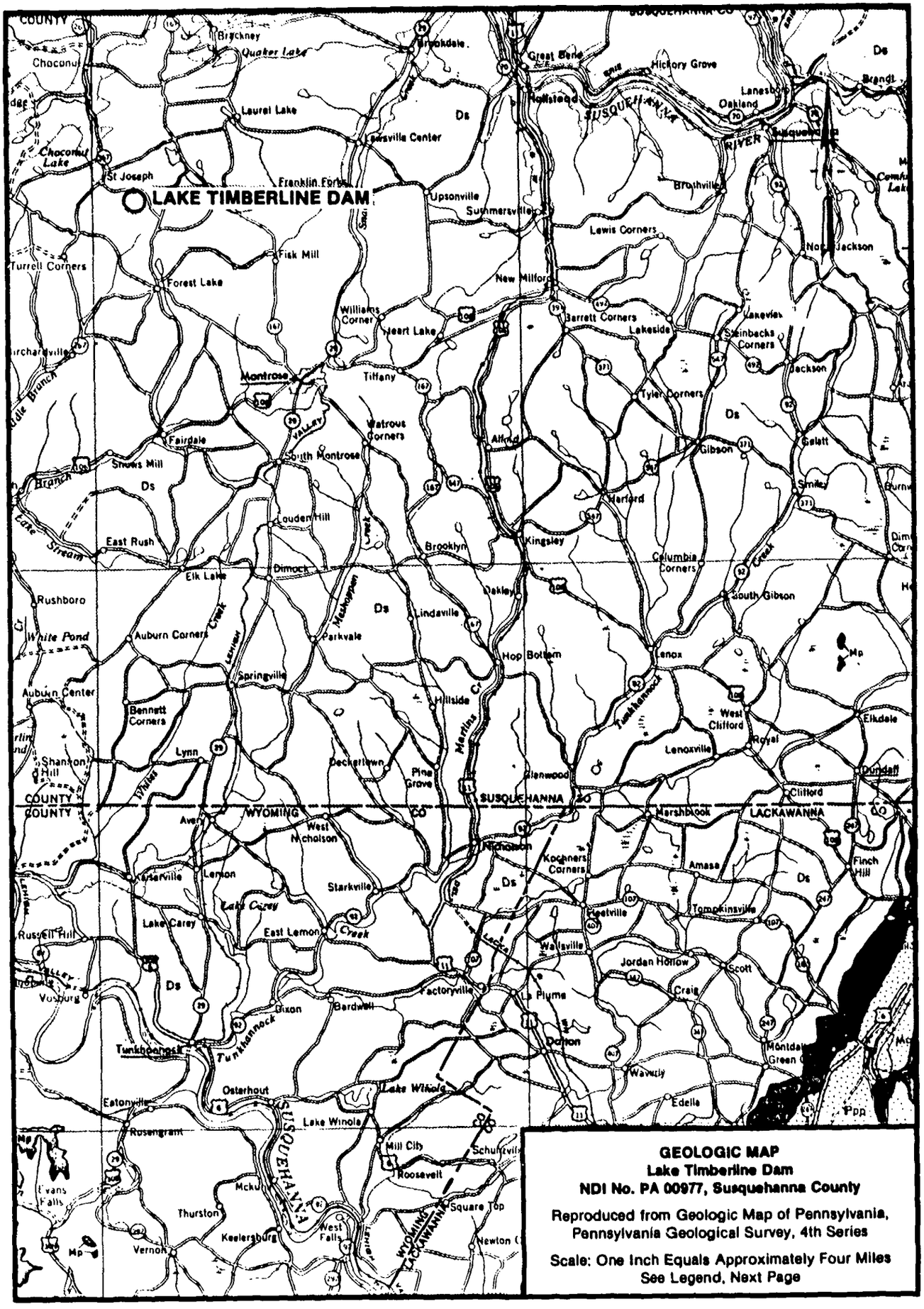
Lake Timberline Dam
NDI No. PA 00977, PennDER No. 58-125

REGIONAL GEOLOGY

Lake Timberline Dam is located in the glaciated northeast section of the Appalachian Plateaus physiographic province. The impounded lake occupies the middle of an unnamed stream valley. The lake is fed by drainage from two intermittent streams. Drainage from the lake flows to the west where it eventually forms a confluence with Choconut Creek. Choconut Creek, in turn, flows to the Susquehanna River. The average topographic relief from the hilltops to the Choconut Stream Valley is 500 feet.

The study area has been glaciated at least three times and is presently overlaid by the glacial ground moraine of the Nebraskan, Kansan, and Wisconsin glaciations. Three borings were performed along the centerline of the dam. One boring indicated "sand-gravel, loam clay." Additional information other than the information presented for these three was unavailable for review; and the information from these three borings is considered meager. Therefore, the extent and thickness of the soil types is difficult to ascertain. According to the Soil Conservation Service survey for Susquehanna County, soils in the vicinity of the lake consist of Volusia flaggy to channery silt loams on slopes that range from 8 to 25 percent.

Geologic data taken from the Geologic Map of Pennsylvania indicates that bedrock in the vicinity of the lake is composed of rocks of the Devonian Susquehanna Group. Bedrock of this group has been subdivided in other sections of the state into the Marine Beds, the Catskill Formation, and the Oswayo Formation. The rocks underlying the dam are most likely of the Catskill Formation. This formation is composed chiefly of red to brownish shales and sandstones; including gray and greenish sandstone tongues named Elk Mountain, Honesdale, Shohola, and Delaware River in the east.



GEOLOGIC MAP
Lake Timberline Dam
NDI No. PA 00977, Susquehanna County

Reproduced from Geologic Map of Pennsylvania, Pennsylvania Geological Survey, 4th Series

Scale: One Inch Equals Approximately Four Miles
See Legend, Next Page

GEOLOGY MAP LEGEND

DEVONIAN

UPPER

WESTERN PENNSYLVANIA

Dow Dr

Oswayo Formation

Greenish gray to gray shales, siltstones and sandstones becoming increasingly shaly westward, considered equivalent to type Oswayo, Riceville Formation Dr in Erie and Crawford Counties, probably not distinguishable north of Corry

Dcr

Cattaraugus Formation

Red, gray and brown shale and sandstone with the proportion of red decreasing westward, includes Venango sands of drillers and Salamanca sandstone and conglomerate, some limestone in Crawford and Erie counties.

Dct

Conneaut Group

Alternating gray, brown, greenish and purplish shales and siltstones; includes "pink rock" of drillers and "Chemung" and "Girard" Formations of northwestern Pennsylvania.

Dcn

Canadaway Formation

Alternating brown shales and sandstones, includes "Portage" Formation of northwestern Pennsylvania.

CENTRAL AND EASTERN PENNSYLVANIA

Doo

Oswayo Formation

Brownish and greenish gray, fine and medium grained sandstones with some shales and scattered calcareous nests, includes red shales which become more numerous eastward. Relation to type Oswayo not proven.

Dck

Catskill Formation

Chiefly red to brownish shales and sandstones, includes gray and greenish sandstone tongues named Elk Mountain, Honesdale, Shohola, and Delaware River in the east.

Dm

Marine beds

Gray to olive brown shales, graywackes, and sandstones, contains "Chemung" beds and "Portage" beds including Bucket, Brallier, Harrell, and Trimmers Rock, Tully Limestone at base.

Ds

Susquehanna Group

Barbed line is "Chemung-Catskill" contact of Second Pennsylvania Survey County reports, barbs on "Chemung" side of line.

MIDDLE AND LOWER

Dho

Dh

Hamilton Group

Mahantango Formation

Brown to olive shale with interbedded sandstones which are dominant in places (Montebello); highly fossiliferous in upper part, contains "Centerfield coral bed" in eastern Pennsylvania.

Marcellus Formation

Black, fissile, carbonaceous shale with thick, brown sandstone (Turkey Ridge) in parts of central Pennsylvania.

Onondaga Formation

Greenish blue, thin bedded shale and dark blue to black, medium bedded limestone with shale predominant in most places, includes Selinsgrove Limestone and Needmore Shale in central Pennsylvania and Buttermilk Falls Limestone and Esopus Shale in easternmost Pennsylvania, in Lehigh Gap area includes Palmerton Sandstone and Bowmanstown Chert.

Dmo

Do

Oriskany Formation

White to brown, fine to coarse grained, partly calcareous, locally conglomeratic, fossiliferous sandstone (Ridgely) at the top; dark gray, cherty limestone with some interbedded shales and sandstones below (Shriver).

Dhb

Helderberg Formation

Dark gray, calcareous, thin bedded shale (Mandata) at the top, equivalent to Port Ewen Shale and Becraft Limestone in the east, dark gray, cherty, thin bedded, fossiliferous limestone (New Scotland) with some local sandstones in the middle, and, at the base dark gray, medium to thick bedded, crystalline limestone (Coeymans), sandy and shaly in places with some chert nodules